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REPORT OF THE
SECRETARY OF AGRICULTURE.

REPORTS OF CHIEFS.



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* * * * *

Section 73, paragraph 2:

The Annual Report of the Secretary of Agriculture shall hereafter be submitted and printed in two parts, as follows: Part One, which shall contain purely business and executive matter which it is necessary for the Secretary to submit to the President and Congress; Part Two, which shall contain such reports from the different Bureaus and Divisions, and such papers prepared by their special agents, accompanied by suitable illustrations, as shall, in the opinion of the Secretary, be specially suited to interest and instruct the farmers of the country, and to include a general report of the operations of the Department for their information. There shall be printed of Part One, one thousand copies for the Senate, two thousand copies for the House, and three thousand copies for the Department of Agriculture; and of Part Two, one hundred and ten thousand copies for the use of the Senate, three hundred and sixty thousand copies for the use of the House of Representatives, and thirty thousand copies for the use of the Department of Agriculture, the illustrations for the same to be executed under the supervision of the Public Printer, in accordance with directions of the Joint Committee on Printing, said illustrations to be subject to the approval of the Secretary of Agriculture; and the title of each of the said parts shall be such as to show that such part is complete in itself.

CONTENTS.

REPORT OF THE SECRETARY.

	Page.
The agricultural effort.....	4
Acreage.....	5
Yields.....	5
Values.....	8
Plans for 1918.....	9
Cooperation of official agencies.....	10
Cooperative extension service.....	12
Work of the department.....	13
Meat supply.....	15
Overcoming animal diseases.....	16
Predatory animals.....	18
National forest ranges.....	19
Dairy products.....	19
The Federal meat inspection.....	20
Good food for soldiers and sailors.....	20
Market News Services.....	20
Fruits and vegetables.....	21
Live stock and meats.....	21
Dairy and poultry products.....	22
Grain, hay, and feed.....	22
Seeds.....	23
Local market reporting service.....	23
Inspection of food products.....	23
United States grain standards act.....	24
Distribution of low-grade cotton.....	25
The pink bollworm of cotton.....	26
Texas border quarantine service.....	27
The situation in Mexico.....	28
Nursery stock importations.....	29
Citrus canker.....	29
Crop estimates.....	30
Seed-grain loans in drouth areas.....	32
The farm-labor supply.....	35
Publication and information work.....	35
Information service.....	36
Exhibits.....	37
Motion pictures.....	38
Purchase and distribution of nitrate of soda.....	38
Highway construction.....	39
United highways council.....	40
Forest fires.....	41
Water power.....	42
Recent legislation and development.....	42

	Page.
Further steps.....	43
Personal credits.....	43
Land settlement.....	45
Further highway development.....	49
Stockyards and packing houses.....	50
Federal feed and fertilizer laws.....	52
Emergency production work.....	52
Rural health and sanitation.....	53
REPORTS OF CHIEFS.	
Report of the Chief of the Weather Bureau.....	57
War conditions.....	57
War activities.....	58
Forecasts and warnings.....	59
Stations and observations.....	61
Aerological investigations.....	62
Work in climatology.....	63
Ocean meteorology.....	64
Data and information supplied.....	64
Telegraph service.....	61
River and flood service.....	65
Printing and publications.....	66
Library.....	67
Seismological investigations.....	67
Solar radiation investigations.....	68
Agricultural meteorology.....	68
Instrumentation, tests, and repairs.....	70
Report of the Chief of the Bureau of Animal Industry.....	71
War activities.....	71
Animal husbandry division.....	77
Dairy division.....	87
Meat inspection division.....	98
Quarantine division.....	104
Field inspection division.....	107
Tick eradication division.....	108
Tuberculosis eradication division.....	110
Pathological division.....	112
Biochemic division.....	118
Zoological division.....	123
Miscellaneous division.....	126
Office of hog-cholera control.....	127
Office of virus-serum control.....	128
Experiment station.....	129
Experiments and demonstrations in live-stock production in the cane-sugar and cotton districts.....	131
Report of the Acting Chief of the Bureau of Plant Industry.....	135
Work and organization of the bureau.....	135
Plant breeding.....	136
Investigations of the quality of seed.....	141
Seed stocks committee.....	142
Agronomic and horticultural investigations.....	143
Agricultural industries on reclamation products.....	148

Report of the Acting Chief of the Bureau of Plant Industry—Continued.	Page.
Crop utilization.....	150
Plant pathological investigations.....	153
Plant physiological investigations.....	158
New crop plants and crop extension.....	161
Report of the Forester.....	165
The forest service in war times.....	165
The National Forests.....	166
Cooperation with States.....	193
War research work.....	193
Miscellaneous.....	200
Report of the Chemist.....	201
Enforcement of the food and drugs act.....	202
Conservation of foodstuffs.....	208
Demonstration.....	209
Cooperation with war agencies.....	211
Technological investigations.....	214
Research.....	217
Collaboration.....	223
Report of the Chief of the Bureau of Soils.....	225
Soil Survey.....	225
Chemical investigations.....	230
Fertilizer resources investigations.....	230
Soil physics.....	232
Report of the Entomologist.....	233
Deciduous-fruit insect investigations.....	233
Cereal and forage insect investigations.....	237
Stored product insect investigations.....	240
Investigations of insects injurious to vegetable and truck crops.....	240
Southern field-crop insect investigations.....	243
Insects affecting the health of man and animals.....	243
Investigations of insects affecting forest resources.....	244
Tropical and subtropical fruit insect investigations.....	245
Extension and demonstration work.....	247
War emergency entomological intelligence service.....	249
Bee-culture investigations.....	250
Work on the gipsy moth and brown-tail moth.....	253
Report of Chief of Bureau of Biological Survey.....	257
Work of the Bureau of Biological Survey.....	257
Economic investigations.....	257
Biological investigations.....	265
Mammal and bird reservations.....	266
Interstate commerce in game.....	271
Federal migratory bird law.....	273
Report of the Chief of the Division of Accounts and Disbursements.....	277
Character of work.....	277
Work of the year.....	277
Report of the Chief of the Division of Publications.....	281
Summary of publications.....	281
Allotments and expenditures.....	282
Statistics of the publication work.....	287
Farmers' Bulletins.....	288
Publications relating to food production and conservation.....	291
Publication work of the Weather Bureau.....	293
Sales of Department publications.....	294
Work of the division by branches.....	295

	Page.
Report of the Chief of the Bureau of Crop Estimates.....	305
Administrative office.....	305
Cooperation with the Census Bureau.....	307
Field service.....	307
Division of crop reports.....	309
Division of truck crops.....	310
Division of crop records.....	312
Bureau library.....	313
International Institute of Agriculture.....	313
Fruit crop estimates.....	313
Publications.....	314
Monthly crop report.....	314
Tribute to American farmers.....	317
Report of the Librarian.....	319
Work of the year.....	319
Reference and loan divisions.....	319
Accessions.....	322
Cataloguing and classification.....	323
Biographical work.....	323
Periodicals and other serials.....	324
Binding.....	325
Affiliated activities.....	325
Publications.....	326
Library staff.....	326
War service.....	327
Bureau, division, and office libraries.....	327
Appendices.....	329
Report of the Director of the States Relations Service.....	335
Introduction.....	335
Office of the director.....	338
Office of experiment stations.....	342
Office of extension work in the South.....	351
Office of extension work in the North and West.....	358
Office of home economics.....	369
Report of the Director of the Bureau of Public Roads.....	373
War work.....	373
Federal aid road act.....	375
National forest roads.....	380
Road building and maintenance investigation.....	381
Road management and economics.....	381
Road material tests and research.....	383
Farm irrigation investigations.....	387
Drainage investigations.....	388
Rural engineering.....	390
Report of the Solicitor.....	393
Summary.....	393
The national forests.....	398
The plant quarantine act.....	404
Federal aid road act.....	404
Weeks forestry law.....	406
The food and drugs act.....	407
Meat inspection.....	415

Report of the Solicitor—Continued.	Page.
Twenty-eight hour law.....	416
Acts regulating the interstate movement of live stock from quarantined districts, prohibiting the interstate movement of diseased live stock, and prohibiting the importation of diseased live stock.....	417
The virus act.....	417
The insecticide act.....	418
The Lacey Act.....	418
Bird reserves trespass law.....	419
United States cotton futures act.....	419
United States grain standards act.....	419
United States warehouse act.....	420
Standard container act.....	420
Food control act.....	420
Food production act.....	421
Miscellaneous work for the Bureau of Markets.....	421
General statutes.....	421
Patents.....	421
Publications of the office.....	424
Report of the Insecticide and Fungicide Board.....	425
Interstate samples.....	425
Import samples.....	426
Percentage of violations.....	426
Special investigations.....	427
Report of the Federal Horticultural Board.....	431
Lines of work.....	431
The pink bollworm.....	432
Cotton importations.....	438
Nursery stock importations.....	440
Plant quarantines.....	444
Cooperative work.....	444
Terminal inspection of interstate mail shipments of plants and plant products.....	445
Violations of the plant quarantine act.....	445
Potato wart in the United States.....	445
List of current quarantine and other restrictive orders.....	447
Report of the Chief of the Bureau of Markets.....	451
Investigational work.....	453
Service work.....	473
Regulatory work.....	482
Publications during the year.....	487
Report of the Acting Chief of the Office of Farm Management.....	491
Farm labor problems.....	492
Crop economics.....	493
Live-stock economics.....	494
Farm-equipment investigations.....	494
Farm tenure.....	495
Financial analyses of the farm business.....	495
Farm bookkeeping and accounting.....	496
History and distribution of farm enterprises.....	496
Farm practice in relation to maintenance of crop yields.....	496
Problems of management in specific areas.....	497
Farm management demonstration work in the Southern States.....	499
Index.....	501

REPORT OF THE SECRETARY OF AGRICULTURE.

REPORT OF THE SECRETARY OF AGRICULTURE.

WASHINGTON, D. C., *November 15, 1918.*

SIR: The part the millions of men, women, boys, and girls on the farms and the organized agricultural agencies assisting them, including the Federal Department of Agriculture, the State colleges and departments of agriculture, and farmers' organizations, played during the war in sustaining this Nation and those with which we are associated is striking but altogether too little known and appreciated. On them rested the responsibility for maintaining and increasing food production and for assisting in securing fuller conservation of food and feed stuffs. The satisfactory execution of their task was of supreme importance and difficulty.

The proper utilization of available foods is one thing; the increase of production along economic lines is quite a different thing. It is prerequisite and fundamental. It is one thing to ask a man to save; it is another to ask him, confronted as he is by the chances of the market and the risk of loss from disease, flood, and drouth, to put his labor and capital into the production of food, feeds, and the raw material for clothing.

The work of the agricultural agencies is not much in the public eye. There is little of the dramatic about it. The millions of people in the rural districts are directly affected by it and are in more or less intimate touch with it, but to the great urban population it is comparatively unknown. Usually people in cities devote very little thought to the rural districts; and many of them fortunately, in normal times, have to concern themselves little about the food supply and its sources. The daily press occupies itself largely with the news of the hour, and the magazines have their attention centered chiefly on other activities. Consequently, the people in large centers have slight opportunity to acquaint themselves with rural problems and agencies. Although the Nation has, in its Federal Department and the State colleges and departments, agricultural agencies for the

improvement of farming which, in point of personnel, financial support, and effectiveness, excel those of any other three nations combined, very many urban people were unaware of the existence of such institutions, and not a few representations were made to the effect that an administration ought to be created to secure an increase of production. These people have seen the windows of cities placarded and papers filled with pleas for conservation, for investment in bonds, and for subscriptions to the Red Cross. They have wondered why they have not seen similar evidence of activity in the field of agriculture. They did not know of the thousands of men and women quietly working in every rural community of the Nation and of the millions of bulletins and circulars dealing with the problems from many angles. They overlooked the fact that the field of these workers lies outside of the city and did not recognize that both the problem and the methods were different.

Within the last year there has been a change. The attention of the world has been directed to its food supply, and agriculture has assumed a place of even greater importance in the world's thought. More space has been devoted to it by the daily press and weekly journals and magazines. This is gratifying. The towns and cities, all of them directly dependent upon agriculture for their existence and most of them for their growth and prosperity, must of necessity take an intelligent, constructive interest in rural problems and in the betterment of rural life. This they can do effectively only as they inform themselves and lend their support to the carefully conceived plans of Federal and State organizations responsible for leadership and of the more thoughtful and successful farmers. For some time it has been part of the plans of this Department to enlist the more complete cooperation of bankers and other business men and of their associations in the effort to make agriculture more profitable and rural communities more healthful and attractive. Recent events have lent emphasis to the appeals and very marked responses have been made in every part of the Union.

THE AGRICULTURAL EFFORT.

The efforts put forth by the farmers and the agricultural organizations to secure increased production can perhaps best be concretely indicated in terms of planting operations. The size of the harvest may not be the measure of the labors of the farmers. Adverse

weather conditions and unusual ravages of insects or plant diseases may partly overcome and neutralize the most exceptional exertions.

ACREAGE.

The first year of our participation in the war, 1917, witnessed the Nation's record for acreage planted—283,000,000 of the leading cereals, potatoes, tobacco, and cotton, as against 261,000,000 for the preceding year, 251,000,000 for the year prior to the outbreak of the European war, and 248,000,000 for the five-year average, 1910–1914. This is a gain of 22,000,000 over the year preceding our entry into the war and of 35,000,000 over the five-year average indicated. Even this record was exceeded the second year of the war. There was planted in 1918 for the same crops 289,000,000 acres, an increase over the preceding record year of 5,600,000. It is especially noteworthy that, while the acreage planted in wheat in 1917 was slightly less than that for the record year of 1915, it exceeded the five-year average (1910–1914) by 7,000,000; that the acreage planted in 1918 exceeded the previous record by 3,500,000; and that the indications are that the acreage planted during the current fall season will considerably exceed that of any preceding fall planting.

YIELDS.

In each of the last two years climatic conditions over considerable sections of the Union were adverse—in 1917 especially for wheat and in 1918 for corn. Notwithstanding this fact, the aggregate yield of the leading cereals in each of these years exceeded that of any preceding year in the Nation's history except 1915. The estimated total for 1917 was 5,796,000,000 bushels and for 1918, 5,638,000,000 bushels, a decrease of approximately 160,000,000 bushels. But the conclusion would be unwarranted that the available supplies for human food or the aggregate nutritive value will be less in 1918 than in 1917. Fortunately, the wheat production for the current year—918,920,000 bushels—is greatly in excess of that for each of the preceding two years, 650,828,000 in 1917 and 636,318,000 in 1916, and is next to the record wheat crop of the Nation. The estimated corn crop, 2,749,000,000 bushels, exceeds the five-year prewar average by 17,000,000 bushels, is 3.4 per cent above the average in quality, and greatly superior to that of 1917. It has been estimated that of the

large crop of last year, approximately 900,000,000 bushels were soft. This, of course, was valuable as feed for animals, but less so than corn of normal quality. It should be remembered, in thinking in terms of food nutritional value, that, on the average, only about 12 per cent of the corn crop is annually consumed by human beings and that not more than 26 per cent ever leaves the farm. It should be borne in mind also that the stocks of corn on the farms November 1, 1918, were 118,400,000 bushels, as against less than 35,000,000 bushels last year, and 93,340,000 bushels, the average for the preceding five years. It is noteworthy that the quality of each of the four great cereals—barley, wheat, corn, and oats—ranges from 3 to 5.4 per cent above the average.

Equally striking are the results of efforts to secure an ampler supply of meat and dairy products. In spite of the large exportation of horses and mules, the number remaining on farms is estimated to be 26,400,000, compared with 25,400,000 for the year preceding the European war and 24,700,000, the annual average for 1910–1914. The other principal classes of live stock also show an increase in number—milch cows of 2,600,000, or from 20,700,000 in 1914 to 23,300,000 in 1918; other cattle of 7,600,000, or from 35,900,000 to 43,500,000; and swine of 12,500,000, or from 58,900,000 to 71,400,000. Within the last year, for the first time in many years, there was an increase in the number of sheep—1,300,000, or from 47,616,000 in 1917 to 48,900,000 in 1918.

In terms of product the results are equally striking. The number of pounds of beef for 1918 is given at 8,500,000,000 pounds, as against 6,079,000,000 for 1914; of pork, at 10,500,000,000, as against 8,769,000,000; and of mutton, at 495,000,000, as against 739,000,000, a total of all these products of 19,495,000,000 for the last year and 15,587,000,000 for the year preceding the European war.

An increase is estimated in the number of gallons of milk produced, of 922,000,000, or from 7,507,000,000 to 8,429,000,000, and in the pounds of wool of 9,729,000, or from 290,192,000 to 299,921,000. The figures for poultry production have not been accurately ascertained, but it is roughly estimated that in 1918 we raised 589,000,000 head, compared with 544,000,000 in 1914 and 522,000,000, the five-year average, 1910–1914, while the number of dozens of eggs increased by 147,000,000, or from 1,774,000,000 in 1914 to 1,921,000,000 in 1918, and, in the last year exceeded the five-year average by 226,000,000.

The following tables may facilitate the examination of these essential facts:

Acreage of crops in the United States.

[Figures refer to planted acreage.]

Crop.	1918, subject to revision.	1917, subject to revision.	1916	1914	Annual average, 1910-1914.
CEREALS.					
Corn.....	113,835,000	119,755,000	105,296,000	103,435,000	105,240,000
Wheat.....	64,659,000	59,045,000	56,810,000	54,661,000	52,452,000
Oats.....	44,475,000	43,572,000	41,527,000	38,442,000	38,014,000
Barley.....	9,108,000	8,835,000	7,757,000	7,565,000	7,593,000
Rye.....	6,119,000	4,480,000	3,474,000	2,733,000	2,562,000
Buckwheat.....	1,045,000	1,006,000	828,000	792,000	826,000
Rice.....	1,120,400	964,000	869,000	694,000	733,000
Kafirs.....	5,114,000	5,153,000	3,944,000	.....	.....
Total.....	245,475,400	242,810,000	220,505,000	¹ 208,322,000	¹ 207,420,000
VEGETABLES.					
Potatoes.....	4,113,000	4,390,000	3,565,000	3,711,000	3,686,000
Sweet potatoes.....	959,000	953,000	774,000	603,000	611,000
Total.....	5,072,000	5,343,000	4,339,000	4,314,000	4,297,000
Tobacco.....	1,452,900	1,447,000	1,413,000	1,224,000	1,209,000
Cotton.....	37,073,000	33,841,000	34,985,000	36,832,000	35,330,000
Grand total.....	289,073,300	283,441,000	261,242,000	¹ 250,692,000	¹ 248,256,000

¹ Excluding kafirs.

Production in the United States.

[Figures are in round thousands; i. e., 000 omitted.]

Crops.	1918 (unrevised estimate, November, 1918).	1917, subject to revision.	1916	1914	Annual average, 1910-1914.
CEREALS.					
Corn.....bush..	2,749,198	3,159,494	2,566,927	2,672,804	2,732,457
Wheat.....do...	918,920	650,828	636,318	891,017	728,225
Oats.....do...	1,535,297	1,587,286	1,251,837	1,141,060	1,157,961
Barley.....do...	236,505	208,975	182,309	194,953	186,208
Rye.....do...	76,687	60,145	48,862	42,779	37,568
Buckwheat.....do...	18,370	17,460	11,662	16,881	17,022
Rice.....do...	41,918	36,278	40,861	23,649	24,378
Kafirs.....do...	61,182	75,866	53,858	.....	.....
Total.....do....	5,638,077	5,796,332	4,792,634	4,983,143	4,883,819
VEGETABLES.					
Potatoes.....bush..	390,101	442,536	286,953	409,921	360,772
Sweet potatoes.....do...	88,114	87,141	70,955	56,574	57,117
Beans (commercial).....do...	17,802	14,967	10,715	11,585	.....
Onions, fall commercial crop.....do...	13,438	12,303	7,833	(¹)	.....
Cabbage (commercial).....tons..	565	475	252	(¹)	.....
FRUITS.					
Peaches.....bush..	40,185	45,066	37,505	54,109	43,752
Pears.....do...	10,342	13,281	11,874	12,086	11,184
Apples.....do...	197,360	174,608	204,582	253,200	197,898
Cranberries, 3 States.....bbls..	374	255	471	644	.....
MISCELLANEOUS.					
Flaxseed.....bush..	14,646	8,473	14,296	13,749	18,353
Sugar beets.....tons..	6,549	5,980	6,228	5,585	5,391
Tobacco.....lbs..	1,266,686	1,196,451	1,153,278	1,034,679	991,958
All hay.....tons..	86,254	94,930	110,992	88,686	81,640
Cotton.....bales..	11,818	11,302	11,450	16,135	14,259
Sorghum sirup.....galls..	29,757	34,175	13,668	.....	.....
Peanuts.....bush..	52,617	56,104	35,324	.....	.....
Broom corn, 5 States.....tons..	52	52	39	.....	.....
Clover seed.....bush..	1,248	1,439	1,706	.....	.....

¹ No estimate.

Number of live stock on farms on Jan. 1, 1910–1918.

[Figures are in round thousands; i. e., 000 omitted.]

Kind.	1918	1917	1916	1914	Annual average, 1910–1914.
Horses.....	21,563	21,210	21,159	20,962	20,430
Mules.....	4,824	4,723	4,593	4,449	4,346
Milch cows.....	23,284	22,894	22,108	20,737	20,676
Other cattle.....	43,546	41,689	39,812	35,855	38,000
Sheep.....	48,900	47,616	48,625	49,719	51,929
Swine.....	71,374	67,503	67,766	58,933	61,865

Estimated production of meat, milk, and wool.

[Figures are in round thousands; i. e., 000 omitted.]

Product.	1918	1917	1916	1914	1909
Beef ¹.....pounds..	8,593,000	7,384,007	6,670,938	6,078,908	8,138,000
Pork ¹.....do.....	10,500,000	8,450,148	10,587,765	8,768,532	8,199,000
Mutton and goat ¹.....do.....	495,000	491,205	633,969	739,401	615,000
Total.....do.....	19,495,000	16,325,360	17,892,672	15,586,841	16,952,000
Milk ².....gallons..	8,429,000	8,288,000	8,003,000	7,507,000	7,466,406
Wool (including pulled wool).....pounds..	299,921	281,892	288,490	290,192	289,420
Eggs produced ².....dozens..	1,921,000	1,884,000	1,848,000	1,774,000	³ 1,591,000
Poultry raised ².....number..	589,000	578,000	567,000	544,000	³ 488,000

¹ Estimated, for 1914–1917, by the Bureau of Animal Industry. Figures for meat production for 1918 are tentative estimates based upon 1917 production and a comparison of slaughter under Federal inspection for nine months of 1918 with the corresponding nine months in 1917.

² Rough estimate.

³ Annual averages for 1910–1914: Eggs, 1,695,000,000 dozen; poultry, 522,000,000.

VALUES.

On the basis of prices that have recently prevailed, the value of all crops produced in 1918 and of live stock on farms on January 1, including horses, mules, cattle, sheep, swine, and poultry, is estimated to be \$24,700,000,000, compared with \$21,325,000,000 for 1917, \$15,800,000,000 for 1916, \$12,650,000,000 for 1914, and \$11,700,000,000 for the five-year average. Of course, this greatly increased financial showing does not mean that the Nation is better off to that extent or that its real wealth has advanced in that proportion. Considering merely the domestic relations, the true state is indicated rather in terms of real commodities, comparative statements of which are given in foregoing paragraphs. The increased values, however, do reveal that the monetary returns to the farmers have increased proportionately with those of other groups of producers in the Nation and that their purchasing power has kept pace in the rising scale of prices.

PLANS FOR 1919.

It is too early to make detailed suggestions for the spring planting season of 1919. During this fall the Department, the agricultural colleges, and other agencies carried on a campaign for a large wheat acreage, and indications were given by States as to where the requisite planting could be secured without calling for an extension of the area or even a normal acreage in the States which had suffered from drouth for two years. It was suggested that, if possible, at least 45,000,000 acres of wheat should be planted. Fortunately, we have two seasons for wheat sowing, and the Department was aware of the fact that, if a large acreage was planted in the fall and came through the winter in good condition, there would be an opportunity to make appropriate suggestions in reference to the spring operations. The informal indications coming to the Department are that the farmers exceeded the plantings suggested by the Department. We do not know how either the wheat or the rye will come through the winter, and are not now able to state what the requirements should be for the next season, nor can anyone now tell what the world demand will be at the close of the harvest season of 1919. We do know that for the ensuing months the Nation is likely to be called upon for large quantities of available food and feeds to supply not only the peoples with whom we cooperated in the war but also those of the neutrals and the central powers. This will involve a continuation of conservation on the part of our people and probably of the maintenance of a satisfactory range of prices for food products during the period. When the nations of Europe will return to somewhat normal conditions and resume the planting of bread and feed grains sufficient in large measure to meet their requirements, and whether the shipping will open up sufficiently to permit the free movement of grains from distant countries like Australia, India, and Argentina, it is impossible now to say. It is certain that all these nations will direct their attention very specifically to the producing of supplies in respect to which good returns may naturally be expected. It will be to the interest of the whole world to expedite this process as much as possible; and, while the problem of immediate distribution of available foods demands urgent consideration, the production programs for the next harvest should also receive no less common and urgent attention.

Two things seem to be clear. One is that for a considerable period the world will have need particularly of a larger supply than normal of certain live stock, and especially of fats. We must not fail, therefore, to adopt every feasible means of economically increasing these things; and, as a part of our program, we shall give thought to the securing of an adequate supply of feed stuffs and to the eradication and control of all forms of animal disease. The Department has already taken steps in this direction and has issued a circular containing detailed suggestions.

Another is the need of improving the organization of our agricultural agencies for the purpose of intelligently executing such plans as may seem to be wise. We shall attempt not only to perfect the organization and cooperation of the Department of Agriculture, the agricultural colleges and State departments, and the farmers' organizations, but we shall especially labor to strengthen the local farm bureaus and other organizations which support so effectively the extension forces and assist them in their activities. This is highly desirable not only during the continuance of present abnormal conditions but also for the future. The local as well as the State and Federal agencies are of supreme importance to the Nation in all its activities designed to make rural life more profitable, healthful, and attractive, and, therefore, to secure adequate economic production, efficient distribution, and necessary conservation.

The Department of Agriculture, the agricultural colleges, and other organizations will continue to give definite thought to all the problems, will keep close track of developments, and, at the proper time in advance of the next planting season, will lay the situation before the farmers of the Nation. They will attempt to outline the needs and to suggest particular crops the increased production of which should be emphasized.

COOPERATION OF OFFICIAL AGENCIES.

To aid in securing larger production and fuller conservation during 1917 and 1918, the Department and the State colleges and commissioners of agriculture were in cordial cooperation. I can not adequately express my appreciation of the spirit which the State officials manifested in placing themselves at the service of the Government and of the extent, variety, and effectiveness of their efforts in every undertaking. The authorities and staffs of the agricultural

colleges in every State of the Union placed their facilities at the disposal of the Department, supported its efforts and plans with the utmost zeal, and omitted no opportunity, on their own initiative, to adopt and prosecute helpful measures and to urge the best agricultural practice suited to their localities. They not only responded promptly to every request made on them to cooperate in the execution of plans but also liberally made available to the Department the services of many of their most efficient officers. Equally generous was the support of the great agricultural journals of the Union. They gladly sent their representatives to attend conferences called by the Federal Department and through their columns rendered vast service in the dissemination of information.

Very much assistance also was received from the National Agricultural Advisory Committee, created jointly by the Secretary of Agriculture and the Food Administrator for the purpose of securing the views of farmers and farm organizations and of seeing that nothing was omitted to safeguard all legitimate interests. This body, as a whole and also through its subcommittees, studied the larger and more critical agricultural problems confronting the Government, gave many valuable criticisms and highly useful suggestions, and assisted in the several communities in making known the plans and purposes of the Department. The committee included, in addition to representative farmers, the heads of a number of the leading farm organizations. It was composed of former Gov. Henry C. Stuart, of Virginia, a farmer and cattleman and member of the price-fixing committee of the War Industries Board, giving special attention to the consideration of price activities bearing on farm products; Oliver Wilson, of Illinois, farmer and master of the National Grange; C. S. Barrett, of Georgia, president of the Farmers' Educational and Cooperative Union; D. O. Mahoney, of Wisconsin, farmer specializing in cigar leaf tobacco and president of the American Society of Equity; Milo D. Campbell, of Michigan, president of the National Milk Producers' Federation; Eugene D. Funk, of Illinois, ex-president of the National Grain Association and president of the National Corn Association; N. H. Gentry, of Missouri, interested in swine production and improvement and vice president of the American Berkshire Association; Frank J. Hagenbarth, of Idaho, cattle and sheep grower and president of the National Wool Growers'

Association; Elbert S. Brigham, of Vermont, dairyman and commissioner of agriculture; W. L. Brown, of Kansas, wheat grower and member of the State board of agriculture; David R. Coker, of South Carolina, chairman of the State council of defense, successful cotton farmer, and producer of improved types of cotton; W. R. Dodson, of Louisiana, farmer and dean of the Louisiana College of Agriculture; Wesley G. Gordon, of Tennessee, demonstrator of better farming and influential in promoting the introduction of crimson clover and other legumes in his State; John Grattan, of Colorado, agricultural editor, member of the Grange and Farmers' Union, and cattle feeder; J. N. Hagan, of North Dakota, general farmer planting spring wheat on a large scale and commissioner of agriculture and labor; W. W. Harrah, of Oregon, wheat grower, director of the Farmers' Union Grain Agency of Pendleton, and member of the Farmers' Educational and Cooperative Union; C. W. Hunt, of Iowa, general farmer and large corn planter and live-stock producer; H. W. Jeffers, of New Jersey, dairyman, president of the Walker-Gordon Laboratory Co., and member of the State board of agriculture; Isaac Lincoln, of South Dakota, banker and successful grower on a large scale of special varieties of seed grains; David M. Massie, of Ohio, general farmer and successful business man, interested particularly in farm management; William F. Pratt, of New York, general farmer, agricultural representative on the board of trustees of Cornell University, and member of the State Farm and Markets Council; George C. Roeding, of California, fruit grower, nurseryman, and irrigation farmer, and president of the State agricultural society; Marion Sansom, of Texas, cattleman, live-stock merchant, and director of the Federal reserve bank at Dallas; and C. J. Tyson, of Pennsylvania, general farmer and fruit grower and former president of the Pennsylvania State Horticultural Association.

COOPERATIVE EXTENSION SERVICE.

The emergency through which the Nation has passed only served to emphasize the supreme importance of the Cooperative Agricultural Extension Service. It has become increasingly clear that no more important piece of educational extension machinery has ever been created. It has been amply demonstrated that the most effective means of getting information to the farmers and their families and of securing the application of the best scientific and practical proc-

esses is through the direct touch of well-trained men and women. With additional funds made available through the regular agricultural extension act, and especially through the emergency food-production measure, the Department, in cooperation with the State colleges, quickly took steps to expand the extension forces with a view to place in each rural county one or more agents. When this Nation entered the war in April, 1917, there was a total of 2,149 men and women employed in county, home demonstration, and boys' and girls' club work, distributed as follows: County agent work, 1,461; home demonstration work, 545; boys' and girls' club work, 143. In November of this year the number had increased to 5,218, of which 1,513 belong to the regular staff and 3,705 to the emergency force. There were 2,732 in the county agent service, 1,724 in the home demonstration work, and 762 in the boys' and girls' club activities. This does not include the large number of specialists assigned by the Department and the colleges to aid the extension workers in the field and to supplement their efforts.

It would be almost easier to tell what these men and women did not do than to indicate the variety and extent of their operations. They have actively labored not only to further the plans for increased economical production along all lines and carried to the rural population the latest and best information bearing on agriculture, but also to secure the conservation of foods and feeds on the farm; and, in addition, many of them have aided in the task of promoting the better utilization of food products in the cities. They constitute the only Federal machinery in intimate touch with the millions of people in the farming districts. They have, therefore, been able to render great service to other branches of the Government, such as the Treasury in its Liberty Loan campaigns, the Red Cross, the Young Men's Christian Association, and other organizations in their war activities, and the Food Administration in its special tasks.

WORK OF THE DEPARTMENT.

It would require a volume even to outline all the things which the Department of Agriculture has done. It stimulated production, increasingly controlled plant and animal diseases, reducing losses from the cattle tick, hog cholera, tuberculosis, predatory animals, and crop pests, and, in conjunction with the Department of Labor, rendered assistance to the farmers in securing labor. It safeguarded

seed stocks and secured and distributed good seeds to farmers for cash at cost; acted jointly with the Treasury Department in making loans from the President's special fund to distressed farmers in drouth-stricken sections; aided in transporting stock from the drouth areas; greatly assisted in the marketing of farm products, and, under enormous difficulties, helped the farmers to secure a larger supply of fertilizers. At the direction of the President, it is administering under license the control of the stockyards and of the ammonia, fertilizer, and farm-equipment industries.

The Department maintained intimate touch with the War and Navy Departments, the War Industries, War Trade, and Shipping Boards, and the Fuel and Food Administrations. Through the Bureau of Animal Industry, it not only continued to safeguard the meat supply for the civilian population, but it also inspected the meats used at the various cantonments, training camps, forts, posts, and naval stations, and aided in the organization of the veterinary corps. Through the Forest Service it rendered valuable assistance to practically all branches of the Government having to do with the purchase or use of forest products and to many industries which supply war material to the Government, made a thorough study of the lumber situation, aided in many directions the Bureau of Aircraft Production and the Navy Department in the execution of their aeroplane programs, conducted co-operative tests on a large scale at the Forest Products Laboratory, and collaborated in the organization of the forestry regiments. Its Bureau of Markets handled the distribution of nitrate of soda to farmers for cash at cost, cooperated with the War Industries Board in broadening the channels of distribution and stimulating the use of stocks of low-grade cotton, and worked with the Food Administration in the handling of grains and in other of its activities. Its Bureau of Chemistry assisted other departments in preparing specifications for articles needed by them, aided the War Department in the organization of its chemical research work and in making tests of fabrics and supplies, worked out formulas for waterproofing leather, and maintained intimate touch with the related services of the Food Administration. The Department collaborated with the War Department in its handling of the draft, with special reference to its problem of leaving on the farms the

indispensable skilled agricultural laborers. In like manner, through the States Relations Service and the Bureaus of Soils, Roads, Biology, and Entomology, the Department's services have been freely extended to other branches of the Government. It would be impossible in reasonable space to indicate its participation in all directions, and reference must therefore be made to reports of the several bureaus.

MEAT SUPPLY.

Farm animals and their products received a large share of the Department's attention. Efforts were directed toward increasing the output of meat, milk, butter, and other fats, cheese, poultry, eggs, wool, and hides, first, by encouraging the live-stock raiser to make a direct increase in his herds and flocks and their products and, second, by assisting him to prevent loss from disease.

The campaigns for increased production yielded especially fruitful results in respect to pigs and poultry. Indications are that the increase of 15 per cent in pork production this year over 1917, asked for by the Food Administration, will be realized, at least in weight if not in number of hogs. Poultry and eggs also show a material increase, and enormous quantities of the latter were preserved by householders in the season of plenty for use in time of scarcity.

Steps were taken also to encourage the growing of cattle and sheep, but results are naturally slower with these animals than with pigs and poultry. Stockmen in all parts of the country were urged to carry sufficient numbers of cattle in order to make the fullest possible use of pastures and feeds which otherwise would have been wasted; cattle feeders were advised how to save certain grain for human consumption by substituting other feeds for their stock, and efforts were continued to bring about an increase in the number of cattle in the areas freed from ticks.

Through the joint action of the Bureaus of Animal Industry and Markets and the States Relations Service valuable assistance was rendered in the movement of cattle from the drouth-stricken areas of Texas. The county agents in that State, cooperating with the extension workers in Louisiana, Alabama, Georgia, Oklahoma, Mississippi, Arkansas, and Florida, and with the agents of the other bureaus mentioned, indicated to farmers in regions of heavy

crop production the manner in which the cattle could be obtained from the distressed sections and have greatly aided in arranging for their transportation. As a result of their efforts it is estimated that approximately 300,000 head of cattle were saved from starvation or premature slaughter.

OVERCOMING ANIMAL DISEASES.

The increasing control and eradication of animal diseases stimulated production on a more economical basis. For years the Department has been carrying on such work, but during the past year its efforts were greatly extended and more vigorously prosecuted with unusually favorable results.

The cattle tick.—The progress made in the eradication of the southern cattle ticks led to the release from quarantine of 67,308 square miles, the largest area freed in any year since the beginning of the work in 1906. The total free area is now 379,312 square miles, or 52 per cent of that originally quarantined; and the work of the past summer will result in the addition of 79,217 more on December 1. The release of the remainder of the State of Mississippi since my last report makes the first strip of uninfested territory from the interior to the Gulf of Mexico, and the proposed action on December 1 will liberate the entire State of South Carolina, thus opening a broad avenue of free territory to the Atlantic Ocean.

The method of eradication employed is the systematic and regular dipping, throughout the season, in a standard arsenical solution of all cattle in a community. The cost has been from 18 to 50 cents a head, while the enhanced value of each animal greatly exceeds this, one canvass having shown an estimated average increase of \$9.76. The eradication of the ticks not only prevents heavy losses, but also permits the raising of high-class beef cattle and the development of dairying in sections where neither was before economically possible.

Hog cholera.—The ravages of hog cholera, the greatest obstacle to increasing hog production, were greatly reduced as a result of the cooperative campaign conducted in 33 States. The methods of control involved farm sanitation, quarantine, and the application of anti-hog-cholera serum. Data compiled by the Department show that the losses from hog cholera in the year ending March

31, 1918, amounted to only \$32,000,000. as compared with \$75,000,000 in 1914, a reduction of more than 50 per cent in less than five years. Stated in another way, the death rate from hog cholera in the United States was 144 per thousand in 1897, 118 in 1914, and only 42 in 1917, the lowest in 35 years.

The protective serum was used also at public stockyards during the last year. Among the hogs received at market centers there are many which are too light in weight for slaughtering and which should be sent back to farms for further growth and fattening. Formerly, because of the danger of spreading cholera, the Department would not allow hogs to leave public stockyards except for immediate slaughter. The result was that all light-weight hogs sent to the markets were slaughtered. Some of these were young sows suitable for breeding. Now the Bureau of Animal Industry treats these immature pigs with serum and allows them to be shipped out as stockers and feeders. During the past year more than 250,000 head were handled in this way. Their average weight was approximately 100 pounds. It is probable that practically all of them were returned to the markets later at an average weight of 250 to 275 pounds, making an aggregate gain of about 40,000,000 pounds of pork.

Tuberculosis.—Tuberculosis, the most widely distributed destructive disease that now menaces the live-stock industry, recently was made a special object of attack. In cooperation with State authorities and live-stock owners, a campaign was undertaken in 40 States to eradicate tuberculosis from herds of pure-bred cattle, from swine, and in selected areas. At present our efforts are concentrated on the first project, since the pure-bred herds are the foundation of our breeding stock. A plan adopted in December, 1917, by the United States Live Stock Sanitary Association and representatives of breeders' associations, and approved by the Department, was put into operation with the assistance of a large number of herd owners. Herds are tested with tuberculin, and any diseased animals are removed and the premises cleaned and disinfected. Subsequent tests are made at proper intervals. By this means there is being established an accredited list of pure-bred herds from which breeding stock may be secured with reasonable assurance that it is free from tuberculosis. The first list, consisting of more than 1,000 names of owners of herds of pure-bred cattle, representing tests made

up to the end of the fiscal year, was compiled and printed for distribution to breeders.

Parasitic and other diseases.—Enlarged forces and more energetic measures brought further progress in the eradication of the parasitic diseases known as scabies or scab of sheep and cattle. These diseases now linger in only a few small areas. Aid was extended to the War Department and to State and local authorities in reducing and preventing losses from influenza or shipping fever of horses, which has been very prevalent among animals collected for Army purposes. Greater efforts were put forth also to control, reduce, and prevent blackleg, anthrax, hemorrhagic septicemia, contagious abortion, dourine, parasites, plant poisoning, and other diseases which operate to reduce live-stock production.

PREDATORY ANIMALS.

The increasing control and destruction of predatory animals had a direct bearing on live-stock production. During the year there were captured and killed 849 wolves, 26,241 coyotes, 85 mountain lions, and 3,462 bobcats and lynxes. It is estimated that the destruction of these pests resulted in a saving of live stock valued at \$2,376,650.

The cooperative State campaigns organized to exterminate native rodents, mainly prairie dogs, ground squirrels, pocket gophers, and jack rabbits, which annually destroy \$150,000,000 worth of food and feed products, proved to be practical and of great immediate value in increasing grain and forage production. To destroy ground squirrels and prairie dogs on more than 3,295,000 acres of agricultural lands in Montana, 15,865 farmers distributed 276 tons of poisoned grain prepared under direction, while in North Dakota 34,796 treated once approximately 5,430,000 acres and a second time over 7,000,000 acres covered in similar campaigns during the preceding two years. In Idaho the work has been in progress in 22 counties, with more than 4,000 farmers and officials assisting; and it is planned to include every county in the State next year. Similar work was organized and is in progress in Washington, Oregon, Wyoming, Utah, Colorado, Nevada, California, Arizona, and New Mexico in cooperation with agricultural college extension departments, State councils of defense, and other local organizations. Several million bushels of grain and much hay and forage were saved through these

efforts, which will be continued on an enlarged scale during the coming year.

NATIONAL FOREST RANGES.

A very material increase was brought about in the production of meat and wool on the forest ranges. Careful observation of range conditions and study of the methods which would secure the most complete utilization of the forage disclosed that a very considerable increase in the number of animals was possible without overgrazing the forests. The number of cattle under permit for the 1918 season was nearly 2,140,000, and of sheep more than 8,450,000. In two years there were placed on the forests approximately 1,000,000 additional head of live stock, representing about 25,000,000 pounds of beef, 16,000,000 of mutton, and 4,000,000 of wool.

The season of 1918 strikingly illustrated the advantages which the National Forest ranges offer to the western live-stock industry. Throughout the West the ranges outside the forests were generally in bad shape on account of drouth conditions. The live-stock business is becoming precarious for owners who are dependent upon the open public range; many are closing out, and the number of range stock is being reduced. On the other hand, the use of the National Forest ranges is increasing and their productivity is rising under the system of regulation. Never was the wisdom of Government control of these ranges more manifest than at the present time.

DAIRY PRODUCTS.

The Department endeavored to bring about an increase in the output of dairy products by means of more and better cows, improved methods and practices, and the extension of dairying in sections where the industry had not been fully developed. Continued encouragement was given to the development of the dairy industry in Southern and Western States, to the organization and operation of cheese factories in the mountainous regions of the South, and to the building of silos as a means of providing winter feed.

The food value of dairy products was brought to the attention of the consuming public and their economical use advocated. An extensive campaign was waged to encourage the production and consumption of cottage cheese as a means of utilizing for human food skim milk and buttermilk, large quantities of which ordinarily are

fed to live stock or are wasted. Printed matter on the nutritional value of cottage cheese and on the methods of making it was issued in large editions and widely circulated, in cooperation with State extension organizations, and specialists were sent out to encourage its production and consumption.

THE FEDERAL MEAT INSPECTION.

The Federal meat-inspection service covered 884 establishments in 253 cities and towns. There were slaughtered under inspection 10,938,287 cattle, 3,323,079 calves, 8,769,498 sheep, 149,503 goats, and 35,449,247 swine, a total of 58,629,612 animals. Compared with the preceding fiscal year, these figures represent a decline of 5,000,000 in the total number of animals, but an increase of nearly 1,750,000 cattle and more than 600,000 calves. Condemnations amounted to 206,265 animals or carcasses and 528,481 parts of carcasses. The supervision of meats and products prepared and processed covered 7,905,184,924 pounds, and resulted in the condemnation of 17,543,184 pounds. There were certified for export 2,510,446,802 pounds of meat and meat food products.

GOOD FOOD FOR SOLDIERS AND SAILORS.

At the request of the Secretary of War and the Secretary of the Navy, the Department participated in protecting our military and naval forces against unwholesome foods. The Federal meat inspection, which for years has safeguarded the civil population of the United States from bad meat in interstate commerce, was extended to include the special supervision of the meat supply of the American Army and Navy. The examination, selection, and handling of meats and fats are in expert hands from the time the live animals are driven to slaughter until the finished product is delivered in good condition to the mess cooks. Inspectors were assigned to the various cantonments, training camps, forts, posts, and other places in the United States where large numbers of troops are assembled and, at the close of the fiscal year, there were 69 such experts with the Army and 30 with the Navy.

MARKET NEWS SERVICES.

As soon as the appropriations under the food production act became available steps were taken to expand much of the regular work of the Bureau of Markets and to institute certain new lines. The

Market News Services, which had been established on a relatively small scale, were greatly enlarged until at the close of the fiscal year there were approximately 90 branch offices distributing market information to all sections of the country over practically 14,000 miles of leased wires. Many producers, distributors, and others have come to depend on these services and to make less use of commercial price-quoting agencies, which are not able to furnish data so reliable, accurate, prompt, and comprehensive.

FRUITS AND VEGETABLES.

An organization was built up for the national interchange of market information on fruits and vegetables, and the news service on these products was made continuous throughout the year for the first time since it was instituted. Reports were issued in season covering approximately 32 commodities and indicating daily car-lot shipments, the jobbing prices in the principal markets throughout the country, and other shipping-point facts for these crops. In addition to the permanent market stations opened during the period of important crop movements temporary field stations were operated at 82 points in various producing sections, more than twice as many as in the preceding year.

LIVE STOCK AND MEATS.

The news service on live stock and meats was extended to include additional important live stock and meat marketing centers and producing districts. New features also were added to make the service more useful to producers and the trade. The daily reports on meat-trade conditions, which formerly gave information on the demand, supplies, and wholesale prices of western dressed fresh meats in four of the most important eastern markets, now cover also Los Angeles, San Francisco, and Pittsburgh. As a supplement to the daily reports, a weekly review is published. The daily telegraphic report on live-stock shipments west of the Allegheny Mountains was expanded to include all live stock loaded on railroads throughout the United States. Information regarding the "in" and "out" movement in certain feeding districts is being published. This work is valuable in indicating the potential meat supply of the country and will be developed as rapidly as available funds permit.

On June 1, 1918, the Department took over the furnishing of all telegraphic market reports distributed daily from the Chicago Union Stock Yards on live-stock receipts and prices, including not only those regularly sent over the leased wire of the Bureau of Markets but all reports used by commercial news agencies and press associations. The substitution of a Government report for the previous unofficial service has exerted a material influence in restoring confidence in the reports of market conditions, the lack of which has been a fundamental obstacle to the economic development of the live-stock industry.

DAIRY AND POULTRY PRODUCTS.

The news service on dairy and poultry products gives prices of butter, eggs, and cheese, trade conditions, market receipts, storage movement, and supplies in storage and in the hands of wholesalers and jobbers. Since the fall of 1917 it has covered Washington, Boston, New York, Philadelphia, Chicago, Minneapolis, and San Francisco. Data were secured each month from approximately 14,000 dairy manufacturing plants in the United States, showing the quantities produced of such products as whey, process butter, oleomargarine, cheese of different kinds, condensed and evaporated milk, various classes of powdered milk, casein, and milk sugar.

GRAIN, HAY, AND FEED.

Biweekly statements on the stocks of grain, hay, and feed, the supply of and demand for these commodities, and the prices at which they were being bought and sold in carload lots, were issued from New York, Richmond, Atlanta, Chicago, Minneapolis, Kansas City, Oklahoma, Denver, Spokane, and San Francisco.

Through the machinery of these services, emergency work of special value was conducted. At the request of the Director General of Railroads, a survey was made to determine the exact location of the soft corn in the United States and the number of freight cars needed to move it; and, at the request of the Food Administration, the feed requirements of New York, Pennsylvania, and New England were ascertained. Temporary offices were opened in the drouth-stricken regions at Fort Worth, Tex., Bismarck, N. Dak., and Bozeman, Mont., to assist farmers and cattle raisers in securing supplies of feed, and aid was thus given in saving thousands of cattle from starvation or premature slaughter.

SEEDS.

Although it has been apparent for several years that it would be extremely desirable to have available more dependable and complete information on seed-marketing conditions, the situation did not become acute until war was declared. To meet the conditions then encountered, field offices were opened in Chicago, Minneapolis, Kansas City, Atlanta, Spokane, San Francisco, and Denver. Information obtained through them and through voluntary reporters throughout the country is disseminated by means of a monthly publication entitled "The Seed Reporter." The workers connected with this service have cooperated fully with the seed-stocks committee of the Department in furthering effective seed distribution.

LOCAL MARKET REPORTING SERVICE.

What is known as the Local Market Reporting Service covers an entirely new field and is a logical and necessary supplement to the national telegraphic news services. The first experiment was made in Providence, R. I., shortly before the beginning of the last fiscal year and was so successful that, when emergency funds became available, the work was broadened and, in cooperation with local authorities, agents were placed in 15 additional cities. This service consists largely of reports on local market conditions and prices based on daily observations and is conducted primarily for the benefit of growers and consumers, though it is also very useful to dealers. Consumers' figures are made public through the local newspapers and are helpful guides for the housewife. The growers' reports contain brief discussions of market features, changes, and developments, and give tables showing prices received by producers for certain products and, as well, those of wholesale and commission dealers.

INSPECTION OF FOOD PRODUCTS.

Since the fall of 1917 the Department, through the Food Products Inspection Service, has made it possible for shippers to receive certificates from disinterested Federal representatives as to the condition of their fruit and vegetable shipments upon arrival at large central markets. There are now inspectors in 36 of the most important markets of the country. As a result of their activities, perishable foodstuffs entered more quickly into the channels of con-

sumption, cars were released more promptly, and many rejections and reversions prevented. The service was used extensively by the Food Administration and by the Army and Navy in connection with their purchases of food supplies. Inspections are now made not only at the request of shippers but also of receivers and other interested parties.

Owing to the ever-increasing distance between important producing sections and large consuming centers, the question of the conservation of food, both in transportation and storage, has become a vital one. During the past year the results obtained in previous investigational work along these lines were made the basis of extensive demonstrations. Producers were given practical advice regarding the proper methods of picking, grading, packing, handling, storing, and shipping the more perishable products, such as fruits and vegetables. The proper construction not only of storage houses but also of refrigerator and heater cars was carefully studied, and the recommendations of the Bureau of Markets on car construction were accepted by the Railroad Administration and other agencies.

UNITED STATES GRAIN STANDARDS ACT.

The activities necessary to enforce the United States grain standards act were greatly increased during the year. The minimum guaranteed price fixed by the President was based upon the official standards established and promulgated by the Department, effective for winter wheat on July 1 and for spring wheat on August 1, 1918. Until 1917 fixed prices and restricted trading were features unknown in the history of grain marketing, and the wheat crop of that year was the first to be marketed under Federal standards and in compliance with the requirements of the act. Under these extraordinary conditions it was found necessary to revise the Federal wheat standards. This was done after hearings had been held throughout the country, to which producers, country shippers, grain dealers, and all other grain interests were invited. The revised standards harmonize as closely as possible with the desires of producers and consumers, and at the same time preserve fundamental grading principles. A minor revision of the official standards for shelled corn also was made, effective July 15, 1918.

Prior to July 1, 1917, appeals from grades assigned to grain by licensed inspectors could be entertained by the Department only in reference to shelled corn. After that date appeals from the

grades assigned to wheat by such inspectors were considered, thus greatly broadening the scope of the Department's grain-grading activities. Under Government control the price of wheat depends entirely upon its grade, and this fact stimulated appeals for the determination of the true grade. During the period covered by this report approximately 1,250 appeals were taken. This is an increase of more than 100 per cent over the number in the preceding year. Under cooperative arrangements with the Food Administration the services of the grain supervisors of the Department were made available to the United States Grain Corporation in matters pertaining to the grading of grain under its jurisdiction. Grade determinations made in this way extended into the thousands. Wheat moving to large terminal markets was inspected and graded by inspectors licensed by the Department under the grain standards act, and the responsibility of the Department, therefore, with respect to the efficiency of the work of licensed inspectors was greatly enhanced. The records of the Department show that considerable progress was made in this direction, and the methods of supervising the work of licensed inspectors recently adopted should secure further improvement. The demand for the official inspection of grain is steadily increasing. There are now 330 licensed inspectors and 120 inspection points, and within the fiscal year 438,703 cars of corn and 337,344 cars of wheat were graded under the act.

DISTRIBUTION OF LOW-GRADE COTTON.

It has been very difficult to obtain correct commercial differences for cotton during the past season owing to the great demand for the high grades and the falling off of that for the low grades. To add to the difficulty, the latter become concentrated at a limited number of designated spot markets. These markets endeavored to submit correct quotations for them, while other markets were at a loss as to how to arrive at correct differences. This caused some markets to quote the very low grades at a much wider discount than others. The apparent result was that the average differences for these grades were comparatively so narrow as to make their delivery on future contracts very profitable. A further result was that the parity between spot cotton and future cotton was greatly disturbed, future contracts depreciating in value on account of the comparatively high prices at which the low-grade product was delivered on them.

Realizing that it was economically unsound for an appreciable portion of the crop practically to become dead stock and to be excluded from use, this Department took steps to secure its proper utilization, particularly through a modification of Government contracts. It was believed to be feasible to use lower grade cotton without reducing the serviceability of the manufactured fabric. Steps were taken also, through cooperation with the designated spot markets, to assure the accuracy of quotations. It may be desirable to amend the rules for obtaining differences in order to secure more nearly accurate quotations for the grades of which some markets may from time to time become bare. The possibility of formulating a workable plan is being considered.

THE PINK BOLLWORM OF COTTON.

Attention was called last year to the establishment in the Laguna, the principal cotton-growing district of Mexico, of the pink bollworm of cotton. The quarantine action as to Mexican cotton and cotton seed, as well as the provision for a very complete Mexican border control service, was then noted, and reference also was made to the clean-up operations with the mills in Texas which, prior to the discovery of this insect in Mexico, received Mexican cotton seed for crushing.

There were three points of infestation in Texas last year, at Hearne, Beaumont, and the much larger Trinity Bay district. They are under effective control. No additional areas have been found.

The Trinity Bay infestation was the most serious, covering 6,000 acres. It undoubtedly was not due to the importation of cotton seed from Mexico prior to the establishment of the quarantine in 1916. The insect has been present there for three or four years, and it must have been introduced either through some importation of foreign cotton seed in violation of the Federal quarantine, or, as seems more probable, through storm-distributed cotton or cotton seed from Mexico. Following the great storm of 1915, cotton lint and cotton seed, some of which came from the Laguna, Mexico, were observed quite generally about the shores of the bay. The distribution of the insect, as determined in the survey and clean-up work of the fall and winter of 1917-18, strongly supports this theory of origin.

The State of Texas, under the authority of the cotton quarantine act passed by the special session of the State legislature on October

3, 1917, cooperated very materially in the work of extermination. The small district at Hearne, Tex., and the important Trinity Bay region, including Beaumont, involving in whole or in part eight counties in Texas, were placed under quarantine by the State and the growing of cotton in these districts prohibited for a period of three years or longer.

The eradication operations of last fall and winter included the infested and noninfested cotton fields and were carried out, in cooperation with the State of Texas, under special appropriations to the Department of \$50,000, available March 4, 1917, and \$250,000, available October 6, 1917. All standing cotton was uprooted and burned, and scattered bolls and parts of plants were also collected and burned. The seed was milled under proper safeguards and the lint shipped from Galveston to Europe. In the Trinity Bay and Beaumont districts, a total of 8,794 acres of cotton land was cleaned at an average labor cost of \$9.94 per acre.

In addition to these two quarantined areas a border district, comprising the counties of Kinney, Maverick, and Valverde, was placed under control by proclamation of the Governor of Texas. This action was taken because of the infestation of cotton lands in Mexico, nearly opposite Eagle Pass, within 25 miles of the Texas border. The growing of cotton in these counties and its transportation from them are forbidden under the terms of the quarantine for a term of three years or more.

The most encouraging feature of the year's work is the fact that not a single egg, larva, or moth of the pest was found within either of the quarantined areas, or elsewhere in Texas, during the season of 1918. This would seem to indicate the effectiveness of the operations of last year and furnishes reason for expecting the complete extermination of the insect. If this result is achieved, it will be the largest successful entomological experiment of the kind in history.

TEXAS BORDER QUARANTINE SERVICE.

The regulation of the entry into the United States from Mexico of railway cars and other vehicles, freight, express, baggage, and other materials, and their inspection, cleaning, and disinfection, was continued during the year with a view to prevent the accidental movement of cotton and cotton seed. This service covers the ports of El Paso, Laredo, Del Rio, Eagle Pass, and Brownsville. During

the year 25,257 cars have been inspected and passed for entrance into this country.

The general presence of cotton seed necessitated the fumigation of practically all cars and freight coming from Mexico, with the exception of certain cars used for the shipment of ore and lumber. These cars were offered for entry principally at the port of El Paso, and, under arrangement with the importing companies, were thoroughly cleaned of cotton seed at the point of origin before loading, and so certified.

At present the best available means of disinfection involves the use of hydrocyanic-acid gas generated within the cars. This method, however, is unsatisfactory on account of the poor condition of the cars and the fact that it does not destroy insects which may be resting on the exterior. In the circumstances, it was necessary to provide for the requisite disinfection in specially constructed houses capable of containing one or more cars at a time. Contracts have been let for five such houses at the ports indicated, and their construction is now well under way. At Del Rio no railroad crosses the border, and a building is being erected to take care of traffic in wagons and motor trucks. Each structure is provided with a system of generators in which hydrocyanic-acid gas is produced. The expense of disinfection will be assumed by the Department, and a charge will be made only to cover the cost of the labor, other than supervision, and of the chemicals used. Under the law the moneys so received must be turned into the Treasury of the United States. This will result in a very considerable depletion of the appropriation available for the work, and it will, therefore, be necessary to ask Congress for an emergency appropriation to reimburse the fund thus expended.

THE SITUATION IN MEXICO.

The situation in Mexico, as determined by surveys conducted during the last two years, seems to confirm the view that the infestation there is limited to the Laguna district and to two small isolated areas opposite Eagle Pass, Tex. This indicates a much more favorable outlook for the possible future extermination of the insect in Mexico than had been anticipated.

The experiment station established last year by the Department in the Laguna district to study the problem and to conduct field experi-

ments with reference to the substitution of other crops for cotton secured much needed information relating to the habits and food plants of the insect. This information will be very useful in determining the most efficient means of eradication and of preventing the spread of the pest. The wheat and corn crops of the Laguna this year have been unusually successful, and the peanuts and castor-bean crops have given good promise.

NURSERY STOCK IMPORTATIONS.

The need of additional restrictions on the entry into this country of certain classes of nursery stock and other plants and seeds has been under consideration. The danger of introducing destructive diseases with plants having earth about the roots and plants and seeds of all kinds for propagation from little-known or little-explored countries is especially great. The large risks from importations of these two classes arise from the impossibility of properly inspecting the former and from the dangers which can not be foreseen with respect to the latter. Examination of such material is necessarily difficult, and the discovery of infesting insects, particularly if hidden in bark or wood, or of evidences of disease is largely a matter of chance. Such control, therefore, as a condition of entry is a very imperfect safeguard.

There has developed throughout the country a wide interest in the subject which has manifested itself in numerous requests from official bodies all over the Union for greater restriction on plant imports. As a basis for such additional restrictions, a public hearing was held in May at which the whole subject was fully discussed with all of the interests concerned. As a result, it is proposed to issue a quarantine which shall restrict the entry of foreign plants and seeds for propagation substantially to field, vegetable, and flower seeds, certain bulbs, rose stocks, and fruit stocks, cuttings, and scions. The entry of these classes of plants is represented to be essential to the floriculture and horticulture of this country.

CITRUS CANCKER.

Since the autumn of 1914 the Department has cooperated with the Gulf States in a campaign to eradicate the canker disease of citrus fruit and trees. Notwithstanding its wide dissemination before its identity and nature were determined, the prog-

ress of the work has been very satisfactory. There appears to be no doubt that the few infections occurring in South Carolina and Georgia have been located and eradicated, so that further work in these States will not be necessary. The extent of the disease in Florida, where the citrus industry is of great magnitude, has been very greatly reduced. In that State, where the total number of properties found to be infected was 479, scattered through 22 counties, the number remaining under quarantine has been reduced to 47. Only 15 canker-infected trees were discovered during the first six months of 1918. The malady is of such highly infectious and virulent nature, however, that it will be necessary to continue the work in all the citrus-growing areas of the State for some time after the orchards appear to be clean in order to prevent the possibility of outbreaks from any latent or inconspicuous infection that might have escaped the observation of the forces. In Alabama, Mississippi, Louisiana, and Texas it is believed that any further seriously destructive outbreaks of canker can be prevented.

CROP ESTIMATES.

The Bureau of Crop Estimates rendered service of great value to the country by its regular monthly and annual crop reports and by its special inquiries for country-wide information relating to particular phases of agriculture urgently needed for immediate use by the Government. It systematically arranged and translated into American units probably the most complete collection of data in the world relating to the agriculture of foreign countries. Since the beginning of the European war, and more especially since the entry of the United States, it has compiled many statistical statements regarding crop and live-stock production, imports, exports, per capita consumption, and estimated stocks on hand in foreign countries for the Department, the Food Administration, and the War Trade Board.

The Monthly Crop Reports, which include current estimates of acreages planted and harvested, growing condition, forecasts and estimates of yield per acre, total production and numbers of different classes of live stock, farm prices, stocks of grain remaining on farms, farm wages, and progress of farm work, were especially valuable. Upon the information contained in them was based much of the

constructive work of the Department, the Food Administration, the State colleges of agriculture and experiment stations, and many State and local organizations interested in maintaining, conserving, marketing, and distributing the food supply.

For collecting original data the bureau has two main sources of information—voluntary reporters and salaried field agents. The voluntary force comprises 33,743 township reporters, one for each agricultural township; 2,752 county reporters, who report monthly or oftener on county-wide conditions, basing their estimates on personal observation, inquiry, and written reports of aids, of whom there are about 5,500; 19 special lists, aggregating 137,000 names, who report on particular products, such as live stock, cotton, wool, rice, tobacco, potatoes, apples, peanuts, beans, and the like; and 20,160 field aids, including the best informed men in each State, who report directly to the salaried field agents of the bureau. The total voluntary staff, therefore, numbers approximately 200,000, an average of about 66 for each county and 4 for each township. The reporters, as a rule, are farmers. They serve without compensation, and are selected and retained on the lists because of their knowledge of local conditions, their public spirit, and their interest in the work. All except county and field aids report directly to the bureau, and each class of reports is tabulated and averaged separately for each crop and State.

The bureau has 42 salaried field agents, one stationed permanently in each of the principal States or group of small States, and 11 crop specialists. These employees are in the classified civil service. All have had some practical experience in farming. Most of them are graduates of agricultural colleges, and are trained in statistical methods and crop estimating. They travel approximately three weeks each month, the fourth week being required for tabulating and summarizing the data collected. They send their reports directly to the Department in special envelopes or telegraph them in code. These are carefully safeguarded until the Crop Report is issued.

Additional information is secured from the Weather Bureau, the Bureau of the Census, State tax assessors, thrashers, grain mills and elevators, grain transportation lines, the principal live-stock markets, boards of trade and chambers of commerce, growers and shippers' associations, and various private crop estimating agencies.

Specific reports from the field service are assembled in Washington, tabulated, averaged, and summarized separately for each source, each crop, and each State. The resulting figures are checked against one another and against similar data for the previous month, for the same month of the previous year, and for the average of the same month for the previous 10 years; and a separate and independent estimate for each crop and State is made by each member of the crop reporting board, after which the board agrees upon and adopts a single figure for each crop and State.

This, in brief, is an outline of the organization and system which has been developed in the Department through more than half a century of experience in crop estimating, and indicates the care and thoroughness with which Government crop reports are prepared. Because the monthly Government crop reports and annual estimates are fundamentally important as the basis of programs of the Department and the State colleges of agriculture for crop and live-stock production, marketing, distribution, and conservation, for the promotion of agriculture as an industry, for the guidance of individual farmers, for appropriate national and State legislation affecting agriculture and the food supply, it is believed that the crop-reporting service should be strengthened. This should be done through estimates by counties as well as by States. Then a near approach to census completeness and accuracy could be made, especially with reference to crop acreages and numbers of live stock; a clearer differentiation between total production and the commercial surplus would be possible, and the Department would be better able to analyze, chart, and report country and world-wide agricultural conditions with special reference to surplus and deficient crop and live stock production.

SEED-GRAIN LOANS IN DROUTH AREAS.

Acting upon urgent representations that many wheat growers in certain sections of the West who lost two successive crops by winter killing and drouth had exhausted their resources and might be compelled to forego fall planting and, in some cases, to abandon their homes unless immediate assistance was extended, the President, at my suggestion, on July 27 placed \$5,000,000 at the disposal of the Treasury Department and the Department of Agriculture to enable them to furnish aid to that extent. The pri-

mary object of this fund was not to stimulate the planting of an increased fall acreage of wheat in the severely affected drouth areas, or even necessarily to secure the planting of a normal acreage, but rather to assist in tiding the farmers over the period of stress, to enable them to remain on their farms, and to plant such acreage as might be deemed wise under all conditions, with a view to increase the food supply of the Nation and to add to the national security and defense. It was distinctly not intended to be used to stimulate the planting of wheat or any other grain where such planting is not wise from an agricultural view and where other crops or activities are safer.

The Federal land banks of the districts embracing the affected areas were designated as the financial agents of the Government to make and collect the loans. The cooperation of local banks was sought and secured in the taking of applications and in the temporary financing of farmers pending advances of Federal funds upon approved applications and the execution of necessary papers.

Assistant Secretary G. I. Christie was designated to represent the Department of Agriculture in the Northwest, and Mr. Leon M. Estabrook, Chief of the Bureau of Crop Estimates, in the Southwest, in organizing the work and approving seed-loan applications. These officers were instructed to cooperate fully with the land banks in their districts acting for the Treasury Department. Several agronomists and field agents were detailed to assist each of this Department's representatives. The Northwest district included the western portion of North Dakota and portions of Montana and Washington; the Southwest district, portions of western Kansas, Oklahoma, Texas, and eastern New Mexico. Early in August headquarters were established at Great Falls, Mont., and at Wichita, Kans. Conferences were held with specialists of the State colleges of agriculture, and a list of counties was agreed upon in which it was deemed wise to make loans. County agents represented the Department of Agriculture in each county and, with the assistance of local inspection committees made up of members of county farm bureaus and county councils of defense, inspected the fields and verified the sworn statements of the applicants.

Loans were made only to farmers who, by reason of two successive crop failures resulting from drouth in the community had exhausted

their commercial credit. A limit of \$3 an acre on not more than 100 acres was fixed. The farmers agreed to use seed and methods approved by the Department. They signed a promissory note for the amount of the loan, with interest at the rate of 6 per cent, payable in the fall of 1919, and executed a mortgage giving the Government a first lien on the crop to be grown on the acreage specified. Furthermore, provision was made for a guarantee fund, each borrower agreeing to contribute 15 cents for each bushel in excess of a yield of 6 bushels per acre planted under the agreement. A maximum contribution of 75 cents per acre was fixed. The object of this fund is to safeguard the Government against loss. If it exceeds the loss it will be refunded pro rata to the contributors.

The demands for assistance were smaller than had been represented or anticipated. Estimates and suggestions for appropriations ranging from \$20,000,000 to \$40,000,000 had been made. Approximately 1,835 applications were approved in the Northwest for a total of \$371,198, and in the Southwest 8,806 for \$2,025,262, or a total of 10,641 applications, involving \$2,396,460. The number and amount for each State are:

State.	Number.	Amount.
Montana.....	1,480	\$300,919
North Dakota.....	338	65,944
Washington.....	17	4,335
Texas.....	1,336	292,651
Kansas.....	3,531	943,147
Oklahoma.....	3,832	773,271
New Mexico.....	87	16,193
Total.....	10,641	2,396,460

It was recognized that there were farmers in the Northwest who would probably be in even more urgent need of assistance for their spring operations. As soon as it was seen that there would be a considerable unexpended balance from the fall planting activities, announcement was made that it would be expended for the spring planting of wheat. Since the cost of seeding spring wheat is greater than that for the fall, it was indicated that the loan would be made on the basis of \$5 an acre, with a limitation of 100 acres. It appears from a survey of the situation that the remainder of the fund will take care of the urgent cases.

The spirit of the farmers in both sections was exceptionally fine. Only those seem to have sought aid who could not otherwise remain

on their farms and continue their operations. The number who appeared permanently to have abandoned their homes was relatively small. A considerable number of the men found temporary employment either in the industries of the West or on transportation lines, earning enough to provide for the subsistence of their families and to carry their live stock through the winter.

THE FARM-LABOR SUPPLY.

The Department of Agriculture continued throughout the year to give earnest attention to the securing and mobilization of an adequate supply of farm labor. It maintained its representatives, stationed in each State in the spring of 1917, and perfected its own organization, enlisting the more active cooperation of the county agents and other extension workers. It more fully coordinated its activities with the Department of Labor, a representative of this Department having been designated a member of the War Labor Policies Board which was created by the President. It also aided the War Department in connection with the classification of agricultural registrants. Special efforts were made, beginning early in the year, to impress upon the residents of urban communities the necessity of aiding farmers in the planting and harvesting of their crops. The response to appeals along this line was generous. In Kansas, for example, where the situation was especially difficult, the reports indicate that more than 45,000 workers were supplied to farmers to assist in the wheat harvest. The potato crop in two counties in Texas was saved through the aid of the business men in the local communities, and in Illinois 35,000 workers were registered for harvest work. Many other examples could be cited, but the results of all these activities are clearly indicated by the fact that, although the largest acreage on record was planted, the great crops of the year were harvested under difficulties not appreciably greater than those in normal times.

PUBLICATION AND INFORMATION WORK.

The dissemination of useful and timely printed information in relation to agriculture is one of the prime functions of the Department. This is the task primarily of the Division of Publications and the Office of Information. It has reached great proportions. There were published during the year 2,546 documents of all kinds, the editions of which aggregated 97,259,399 copies, an increase of

more than 51.6 per cent over the output of last year. This includes 341 earlier publications, the editions of which totaled 19,947,500, reprinted to supply the continuing demand, and 28,258,500 copies of emergency leaflets, pamphlets, posters, and the like issued in connection with the efforts of the Department to stimulate production. All previous records with regard to new Farmers' Bulletins were broken, 130 new bulletins in this series having been issued, the editions of which aggregated 10,815,000 copies. Of the 236 bulletins reprinted to supply the continuing demand, the editions reached 10,884,000 copies. The total issues of the bulletins in this series, therefore, amounted to 21,699,000 copies.

Noteworthy improvement in the character, form, and general appearance of the bulletins was accomplished during the year. Many of the earlier bulletins were revised and reduced, all extraneous matter eliminated, specific and positive statements substituted, and reprinted with attractive cover designs and text illustrations.

INFORMATION SERVICE.

To meet the increasing needs of the Department for publicity in its campaigns to stimulate food production and conservation, the services to the press of the country were largely extended. In addition to furnishing information to farmers through the agricultural and rural press, the Department has found it wise to present to people of the cities accurate statements of its recommendations and advice on the distribution and saving of food materials; and the work of the Department was enlarged to this end. An illustrated weekly news service is now furnished on request to 3,200 dailies and weeklies, which set the type in their own offices, through plate-making concerns to 250 papers, and to 4,000 smaller weeklies in ready print, a total of 7,450 publications. It is probable that this service reaches 15,000,000 to 20,000,000 readers weekly. A home-garden series and a canning-drying series were distributed in much the same manner.

The Weekly News Letter, enlarged from 8 pages to 16 pages on occasions, has a circulation of 130,000. It reaches newspapers and other publications, Federal and State agricultural workers and co-operators, agricultural leaders, libraries, and chambers of commerce. As the official organ of the Department, it carries material intended to further national agricultural campaigns and publishes official statements. Popular articles discussing the experimental results of

and advice on agricultural methods also are used in more detail than in other departmental news channels.

Through its mimeographed news service, the Department furnishes daily, or as the necessity for prompt distribution demands, timely information regarding its activities to press associations, correspondents, newspapers, agricultural journals, and specialized publications generally or locally. By reason of its increased activities, the amount of material supplied through this channel in the last year has been approximately doubled.

Conferences were held with agricultural editors to determine how the Department could better aid them, to acquaint them with its production programs and purposes, and to obtain their suggestions and enlist their cooperation. The needs of the farm press also were ascertained in an extensive questionnaire in which editors were invited to indicate their requirements in detail and to give other information useful to the Department in further developing its agricultural press service. During the year a reclassification of mailing lists was completed. The lists as now established provide for more intelligent distribution of material generally and locally and make it easier to avoid unnecessary duplication and waste.

EXHIBITS.

At present the Department of Agriculture is the only executive department maintaining an Office of Exhibits. Its purpose is to centralize the administration of the exposition services of the Department and to secure uniformity of practice in designing and displaying its educational exhibits. During the past year this work developed along lines connected with the stimulation of food production and conservation. The demands for exhibits from fair associations and similar organizations were so great that it was impossible fully to meet them.

During the fiscal year ended June 30, 1918, the Department made, through the Office of Exhibits, over 30 exhibitions and demonstrations relating to food production, conservation, and distribution. These exhibitions covered a wide range of territory, from New England to Florida and California, and brought the work of the Department to the direct attention of more than 3,000,000 people. At a number of these fairs the Department's exhibits occupied areas of 5,000 square feet or more, and the attendance ran from 150,000 to 950,000.

In response to a widespread popular request for war exhibits at the larger fairs, the Secretary of Agriculture, on April 5, 1918, addressed a communication to the Secretaries of War, Navy, Interior, and Commerce Departments, and to the Food Administration, and invited a conference of representatives from those Departments to work out, with officers of the Department of Agriculture, a coordinated plan of action. This resulted in the formation of a Joint Committee on Government Exhibits, composed of representatives from each of the Departments named. The expert on exhibits of this Department was made chairman of the committee. A plan was evolved and executed to send an impressive joint Government exhibit to 37 State and other fairs and expositions. It is believed that this exhibit was of the highest value in educating and stimulating the people to greater industrial activities, to larger agricultural production, and to a broader and deeper appreciation of their country and Government.

MOTION PICTURES.

The dissemination of information by means of motion pictures, which hitherto has been conducted only on an experimental basis, was, by action of Congress, given a definite allotment of funds, which enabled the Department to undertake the systematic development of this activity. Films prepared in the Department's laboratory were used very effectively in connection with its efforts to recruit farm labor, encourage the preservation of perishable fruits and vegetables, prevent forest fires, and stimulate agricultural production. They were shown, through the extension service, to approximately 500,000 people at demonstration meetings, county and State fairs, schools, churches, and municipal gatherings, and, by arrangement with one of the commercial companies, to about 4,000,000 people at motion-picture theaters. The film companies actively cooperated with the Department and rendered valuable assistance by placing information and appeals of an emergency character before the patrons of the theaters served by them.

PURCHASE AND DISTRIBUTION OF NITRATE OF SODA.

The food control act, which authorized the President to procure and sell nitrate of soda to farmers at cost for the purpose of increasing production, appropriated \$10,000,000 for that purpose. By direc-

tion of the President, the War Industries Board made arrangements for the purchase of the nitrate and the Secretary of Agriculture for its sale and distribution. The Bureau of Markets was designated as the agency to handle the work for the Department.

Contracts were made for the purchase of about 120,000 short tons of nitrate, and arrangements were effected through the Shipping Board to secure tonnage for transporting it from Chile. A selling price of \$75.50 on board cars at port of arrival was announced in January, 1918, and farmers were given an opportunity to make applications through the county agents and committees of local business men appointed for the purpose. Applications for amounts totaling more than 120,000 tons were received from 75,000 farmers, who asked for lots ranging from one-tenth of a ton to more than 100 tons. On account of the lack of available shipping it was possible to bring in, up to June 30, 1918, only about 75,000 tons, practically all of which actually was sent to farmers by that date.

Some of the nitrate was shipped direct to farmers, but the greater part was consigned to county distributors in the counties requiring large quantities. These distributors were appointed when it became evident early in the year that, on account of the lack of vessels, sufficient nitrate would not arrive in time to make complete delivery during the period of greatest need. Through them it was possible to make quick and equitable distribution and to save farmers the interest on deposits required for payments, since shipments for the county were made to the distributors on sight draft with bill of lading attached and distribution was made by them to the farmers. On June 30, there remained in Chile between 39,000 and 40,000 short tons of nitrate for which the Department had been unable to secure transportation to this country from the Shipping Board.

HIGHWAY CONSTRUCTION.

Considerably in advance of the highway construction season of 1918 steps were taken to conserve money, labor, transportation, and materials in highway work and at the same time to facilitate the progress of really essential highway projects.

In connection with the Federal aid road work, a letter was addressed to each State highway department asking that a program of Federal aid construction be submitted at the earliest possible date, in which would be included only those projects which the State

highway departments considered vitally necessary to the transportation facilities of the country. Such programs were submitted by all of the States, and evidence of the thoroughness with which highway projects were considered is disclosed in the statement that, while \$14,550,000 were available for expenditure on post roads from the passage of the act, only \$425,445 were paid from Federal funds on all projects. Projects, however, were approved for each State involving sufficient amounts to protect the States in their apportionments.

At the same time a cooperative arrangement was effected, at the request of the Capital Issues Committee, under which engineers of the Department were made available for inspecting and reporting upon proposed highway, irrigation, and drainage bond issues. This work assumed considerable proportions almost immediately. Inspections were made of 126 highway projects, involving bond issues to the amount of \$49,276,366; irrigation projects to the number of 25, involving \$18,279,060; and drainage bonds to the number of 30, involving \$19,356,970, or total bond issues of \$86,912,396.

In view of the enormous amount of bituminous materials, comprising oils, asphalts, and tars, used in highway work, and particularly in highway maintenance, it became early in the season a matter of much concern as to what effect the conservation of fuel oils and tars would have upon the vitally important problem of highway maintenance. Accordingly, the matter was taken up with the Fuel Administration and an arrangement perfected whereby the highways of essential importance should receive enough bituminous material to provide for adequate maintenance and, where necessary, to permit construction and reconstruction. The cooperation became actively effective on May 13, 1918. From that time until the close of the fiscal year 2,235 applications, calling for 75,000,000 gallons of bituminous material, were received from States, counties, and municipalities, and of this amount approval was given and permits issued for 58,000,000 gallons. A short time before the close of the fiscal year, however, this cooperation was merged into the larger activities of the United States Highways Council.

UNITED STATES HIGHWAYS COUNCIL.

In order to coordinate the activities of various Government agencies so far as they relate to highways; to better conserve materials, transportation, money, and labor; to eliminate delays and uncer-

tainties; and to provide positive assistance in carrying on vitally essential highway work, I requested each of the Government departments and administrations interested to name a representative to serve on a council to deal with highway projects during the period of the war. As a result, the United States Highways Council, consisting of a representative from the Department of Agriculture, the War Department, the Railroad Administration, the War Industries Board, and the Fuel Administration, was formed in June. During the first four months of its existence, the council passed upon about 5,000 applications, involving nearly 4,000,000 barrels of cement, 3,250,000 tons of stone, 1,140,000 tons of gravel, 1,207,000 tons of sand, over 77,000,000 brick, and nearly 20,000,000 pounds of steel, and 140,000,000 gallons of bituminous materials.

FOREST FIRES.

Protection of the forests against disastrous fires proved an exceptionally difficult task. An unusual strain was imposed on an organization somewhat depleted in numbers and much weakened by the loss of many of its most experienced men. Added to this was the difficulty of securing good men for temporary appointment as guards during the fire season and bodies of men for fighting large fires. An unusually early and severe dry season caused the outbreak of serious fires before the summer protective organization was fully ready for them. Some embarrassment in meeting the situation was caused by the failure of the annual appropriation act to pass Congress until after the fire season was virtually over. Ordinarily, expenditures during the summer months are greater than those for the remainder of the fiscal year. Therefore, the sums available under the continuing appropriation of one-sixth of the annual appropriation for the preceding year to cover the months of July and August were insufficient to meet the situation. Relief was furnished by the President, who placed \$1,000,000 at my disposal as a loan from his emergency fund. It may be necessary to seek from Congress again a deficiency appropriation of \$750,000.

The greater part of the extra outlay for fire fighting was on a relatively small number of forests in the Northwest which present conditions of great difficulty. These forests for the most part are rugged, unbroken wilderness. While the Forest Service for years has been attempting to develop a system of communications in the

form of trails, telephone lines, and roads to facilitate the early discovery of fires and quick action to extinguish them, the funds available for construction work have been too limited to permit of rapid progress. There is no resident population at hand to draw upon for fire fighters, so that when large fires develop forces must be organized in towns and cities scores if not hundreds of miles away, transported by railroad to the points nearest the fire, sent long distances into the woods, and there provided with equipment and food by pack trains. The inevitable result of such conditions is that fires which in other regions would be quickly put out, gain headway, burning, perhaps, for several days before the effort to bring them under control can begin. There should be provision for pushing more rapidly the improvement work on these forests, for a greater number of forest guards, and for the earlier organization of the protective system each fire season. For these purposes, the estimates submitted to Congress include increases for specific forests totaling \$230,808.

WATER POWER.

In my report of last year I emphasized the need of water-power legislation and, since three departments would be directly involved, suggested that it contain a provision for an administrative commission composed of the Secretaries of War, the Interior, and Agriculture. After prolonged consideration by a special water-power committee, a measure was drafted and was passed by the House of Representatives. Its early enactment into law would remove many uncertainties in the water-power situation and would directly conduce to the public interest.

RECENT LEGISLATION AND DEVELOPMENT.

The last five years have been especially fruitful of legislation and of its practical application for the betterment of agriculture. Special provision was made for the solution of problems in behalf of agriculture, embracing marketing and rural finance. The Bureau of Markets, unique of its kind and excelling in range of activities and in financial support any other similar existing organization, was created and is rendering effective service in a great number of directions. Standards for staple agricultural products were provided for and have been announced and applied under the terms of the cotton futures and grain standards acts. Authority to license

bonded warehouses which handle certain agricultural products was given to the Department, and the indications are that, with the return of normal conditions the operation of the act will result in the better storing of farm products, the stabilization of marketing processes, and the issuance of more easily negotiable warehouse receipts. The agricultural extension machinery, the greatest educational system ever devised for men and women engaged in their daily tasks, had very large and striking development. The Federal aid road act, approved shortly before this country entered the war, resulted in legislation for more satisfactory central highway agencies in many States and the systematic planning of road systems throughout the Union. To-day each State has a highway authority, with the requisite power and with adequate funds to meet the requirements of the Federal measure. The Federal reserve act, which has benefited every citizen through its influence on banking throughout the Union, included provisions especially designed to assist the farming population. It authorized national banks to lend money on farm mortgages and recognized the peculiar needs of the farmer by giving his paper a maturity period of six months. This was followed by the Federal farm loan act, which created a banking system reaching intimately into the rural districts and operating on terms suited to the farm owners' needs. This system began operations under the troubled conditions of the world war, and its activities were impeded by the vast changes incident to the entry of this country into the conflict. But, in spite of these difficulties, it has made remarkable headway, and there is little doubt that, after the return of peace, its development will be rapid and will more than fill the expectations of the people.

FURTHER STEPS.

PERSONAL CREDITS.

It still seems clear that there should be provided a system of personal-credit unions, especially for the benefit of individuals whose financial circumstances and scale of operations make it difficult for them to secure accommodations through the ordinary channels. Organized commercial banks make short-term loans of a great aggregate volume to the farmers of the Nation possessing the requisite individual credit, but there are many farmers who, because of their

circumstances, are prevented from securing the accommodations they need. An investigation by the department to determine the extent to which farmers in the Southern States were dependent upon credit obtained from merchants revealed the fact that 60 per cent of them were operating under the "advancing system." The men I have especially in mind are those whose operations are on a small scale and who are not in most cases intimately in touch with banking machinery, who know too little about financial operations, and whose cases usually do not receive the affirmative attention and sympathy of the banker. Such farmers would be much benefited by membership in cooperative credit associations or unions.

Of course, there are still other farmers whose standards of living and productive ability are low, who usually cultivate the less satisfactory lands, who might not be received for the present into such associations. This class peculiarly excites interest and sympathy, but it is difficult to see how any concrete financial arrangement will reach it immediately. The great things that can be done for this element of our farming population are the things that agricultural agencies are doing for all classes but must do for it with peculiar zeal. The approach to the solution of its difficulty is an educational one, involving better farming, marketing, schools, health arrangements, and more sympathetic aid from the merchant and the banker. If the business men of the towns and cities primarily dependent on the rural districts realize that the salvation of their communities depends on the development of the back country and will give their organizing ability to the solution of the problem in support of the plans of the organized agricultural agencies responsible for leadership, much headway will be made.

The foundation for effective work in this direction is the successful promotion of cooperative associations among farmers, not only for better finance but also for better production, distribution, and higher living conditions. These activities are of primary importance. At the same time, it is recognized that such cooperation can not be forced upon a community, but must be a growth resulting from the volunteer, intelligent effort of the farmers themselves.

The Department has steadily labored especially to promote this movement by conducting educational and demonstrational work. Field agents in marketing have been placed in most of the States to give it special attention, and the county agents and other extension

workers have rendered, and will continue to render, valuable assistance. The operations of the Farm Loan Board, especially in promoting the creation of its farm-loan associations, should be influential and highly beneficial.

What further can be done by the Federal Government directly to stimulate personal-credit unions it is difficult to outline. This matter has received consideration at the hands of many experts and was thoroughly canvassed by a joint committee of Congress. The conclusion, up to the present, seems to be that the field is one primarily for the States to occupy through sound legislation. During the last five years State laws, more or less adapted to the purpose, have been enacted in Massachusetts, New York, Rhode Island, Wisconsin, Texas, North Carolina, South Carolina, Utah, and Oregon. Under these about 125 associations have been organized, but the larger percentage of them have been formed by wage earners in urban centers. The attempt to develop strictly rural credit bodies has met with somewhat more success in North Carolina than elsewhere. In this State the work of promoting and supervising such organizations was placed in charge of an official in the Division of Markets and Rural Organization of the State College of Agriculture. The law of this State was enacted in 1915, and at present 18 credit unions, all of them rural, are in operation. It is noteworthy that the North Carolina law makes special provision for educational and demonstrational activities.

In 1917 the Bureau of Markets prepared a tentative form of a model State personal credits law. This was published in its Service and Regulatory Announcements. In it were embodied the best views on the subject, but it was submitted merely as a tentative plan.

The Department, with its existing forces and available funds, will continue to foster the cooperative movement and to keep in close touch with the Federal Farm Loan Board.

LAND SETTLEMENT.

Interest in land for homes and farms increases in the Nation as the population grows. It has become more marked as the area of public land suitable and available for agriculture has diminished. It is intensified at the present time by reason of the suggestion and desire that returned soldiers and others who may wish to secure farms shall have an opportunity to do so under suitable conditions.

It finds expression, too, in discussions of the number of tenant farmers and in its meaning and significance.

That there is still room in the Nation for many more people on farms is clear. The United States proper contains about 1,900,000,000 acres of land, of which an area of 1,140,000,000 acres, or 60 per cent, is tillable. Approximately 367,000,000 acres, or 32 per cent, of this was planted in crops in 1918. In other words, for every 100 acres now tilled 300 acres may be utilized when the country is fully settled. Of course, much of the best land, especially that most easily brought under cultivation and in reasonably easy reach of large consuming centers, is in use, though much of it, possibly 85 per cent, is not yielding full returns. Extension of the farmed area will consequently be made with greater expense for clearing, preparation, drainage, and irrigation, and for profitable operation will involve marketing arrangements of a high degree of perfection and the discriminating selection of crops having a relatively high unit value.

Increased production can therefore be secured in two ways, namely, through the use of more land and through the adoption of improved processes of cultivation of all land and of marketing. The latter involves the general application of the best methods used by the most skillful farmers and urged by experienced, practical, and scientific experts. It will necessitate seed selection and improvement, plant and animal breeding, soil development through rotation, the discriminating use of fertilizers, the control and eradication of plant and animal diseases, good business practice and thrift, and many other things. It means that farming must be profitable and that society must be willing to pay the price. Under no other condition can farming expand. It means, too, that only as many will or need stay on farms as may be necessary to supply what the consumers will take at prices which will justify production. Many people speak as if they thought there should be no limit to the number engaged in agriculture or to production of crops. The farmer must consider his balance just as much as any other business man. The number of individuals remaining in the farming industry will, in the long run, continue to adjust itself roughly to the economic demand and will increase as it expands or as relative economies are effected.

To a certain extent, we are still pioneering the continent, agriculturally and otherwise, and are still exporters of food, feedstuffs, and materials for clothing. With wise foresight and increased employment of scientific practice, under the stimulation of intelligent agencies, we can take care of and provide for a very much larger population under even more favorable circumstances and in greater prosperity. This is the task to which the Nation has set itself and indicates the responsibility resting upon each individual, and especially upon the farming population and State and Federal agencies responsible for leadership. We have, up to the present, succeeded in this enterprise. In the years from 1900 to 1915 the Nation gained a population of approximately 22,000,000, and they have been fed and clothed in large measure from domestic sources. It is estimated that in the years from 1915 to 1918 the population increased by 3,200,000, of which a very small part was from immigration. We shall, perhaps, gain as many more in the next 15 or 20 years, even if the rate of immigration should not be maintained, for the natural growth in recent years, averaging about three-fourths of a million a year, shows an upward tendency.

It would be desirable to facilitate land settlement in more orderly fashion. This can be effected in a measure by systematic effort on the part of the Federal Government, the States, and the several communities through appropriate agencies to furnish more reliable information, intelligent guidance, and well-considered settlement plans. The Nation has suffered not a little from irresponsible and haphazard private direction of settlement. In many sections, especially in the newer and more rapidly developing ones, the situation has been complicated by the activities of promoters whose main concern was to dispose of their properties. They too frequently succeeded in attracting farmers to localities remote from markets where they either failed to produce crops or met with disaster through lack of market outlets or adequate marketing arrangements.

It is particularly vital that, by every feasible means, the processes of acquiring ownership of farms be encouraged and hastened. This process is real in spite of appearances to the contrary. It has been too generally assumed and represented that tenancy has increased at the expense of ownership and that we are witnessing agricultural deterioration in this direction. Tenancy does present aspects which should cause great concern, but its bright sides have not been suffi-

ciently considered. The situation does not warrant a pessimistic conclusion. In the 30 years from 1880 to 1910 the number of farms in the United States increased from 4,009,000 to 6,362,000, the number of those owned from 2,984,000 to 4,007,000, a gain of 1,023,000, or 34.3 per cent, and the number operated by tenants from 1,025,000 to 2,355,000, a gain of 1,330,000, or 129.9 per cent. But in 1910, five-eighths of the farms and 68 per cent of the acreage of all land in farms were operated by owners and 65 per cent of the improved land. The number of farms increased faster than the agricultural population. The only class not operating farms who could take them up were the younger men, and it is largely from them that the class of tenants has been recruited.

In a recent study of the cases of 9,000 farmers, mainly in the Middle Western States lying in the Mississippi Valley, it was found that more than 90 per cent were brought up on farms; that 31½ per cent remained on their fathers' farms until they became owners and 27 per cent until they became tenants, then owners; that 13½ per cent passed from wage earners to ownership, skipping the tenant stage; and that 18 per cent were first farm boys, then wage earners, later tenants, and finally owners. It is stated, on the basis of census statistics, that 76 per cent of the farmers under 25 years of age are tenants, while the percentage falls with age, so that among those 55 years old and above only 20 per cent are tenants. In the older sections of the country (except in the South, which has a large negro population), that is, in the New England and Middle Atlantic States, the tenant farmers formed a smaller proportion in 1910 than in 1900. This is also the case with the Rocky Mountain and Pacific Divisions, where there has been a relative abundance of lands. The conditions on the whole, therefore, are not in the direction of deterioration but of improvement. The process has been one of emergence of wage laborers and sons of farmers first to tenancy and then to ownership.

The legislative steps that have been taken to promote better credit terms for farmers will have a tendency to hasten this process. The operation of the farm-loan system, through arrangements by which those who have sold lands take a second mortgage subordinate to the first mortgage of the farm-land banks, carrying a relatively low rate of interest, will have a beneficial influence. If further developments can be made through the application of the principle of cooperation,

especially in the formation of personal-credit unions, the conditions will be more favorable. In the meantime special attention and study should be given to the terms of tenancy, including the lease contract, with a view to increase the interest both of the landlord and of the tenant in soil improvement and to make sure that there is an equitable division of the income.

FURTHER HIGHWAY DEVELOPMENT.

Cooperative construction road work under the Federal aid act will be resumed in full measure and be vigorously prosecuted at the earliest possible moment. At the close of the fiscal year approximately \$14,000,000 covered by project agreements were still available for expenditure from Federal and State funds, and immediately thereafter the Federal appropriation of \$15,000,000 for the fiscal year 1919 also became available. Project statements not yet reaching the stage of agreements, involving \$28,000,000 from all sources, have been approved, making an aggregate, for projects either definitely or tentatively agreed upon, of \$42,000,000. The part of this sum from Federal funds is approximately \$16,000,000, leaving uncovered approximately \$14,000,000. If the State contributions for cooperative work continue in the same proportion, there will become available from them approximately \$20,000,000, or a total uncovered, Federal and State, of \$34,000,000. It seems clear, therefore, that if the work proceeds without any undue restriction, its volume will be represented by the cooperative expenditure of over \$70,000,000 during this fiscal year. For the fiscal year 1920 there will be available \$20,000,000 of Federal funds, which will doubtless be met by a larger contribution from State sources.

The activities should promptly be resumed because good roads are essential not only for the promotion of better marketing, the fuller utilization of farm labor, larger and more economical production and orderly distribution, but also for the development of a richer and more attractive rural life. Their importance to urban communities and to industry and trade in general is obvious, but there is also a consideration of an emergency nature which would prompt vigorous action. In the transition from war to peace there will doubtless be a period in which some laborers engaged in war industries and men released from the Army will be seeking new tasks

and, so far as governmental intervention is concerned, the tasks on which they may be employed should be of the highest public utility.

Public works would furnish suitable employment for many unemployed men, and among such enterprises there are few kinds whose construction is better worth expanding and pressing than public roads. Many of the States will probably engage in road building as in normal times from funds which they may have available in addition to those pledged to meet requirements of the Federal law. Cities also will resume operations in this field, but, in view of the transitional difficulties, we should not depend solely on activity under existing law and financial provisions. An additional appropriation from the Federal Treasury, to be expended through this Department, for highway construction would seem to be desirable and fully warranted, and such action is suggested for urgent and serious consideration. If ample funds are made available to the Department, they should be expended on projects selected after consultation with the Federal Departments interested, especially War, Commerce, and Post Office, as well as with the State central highway authorities.

STOCKYARDS AND PACKING HOUSES.

Under the authority conferred upon the President by the food-control act, substantial progress was made by the Department of Agriculture in the regulation and supervision of stockyards and of commission men, traders, order buyers, packers, and others handling or dealing in live stock in or in connection with stockyards. The important results already accomplished in the improvement of live-stock marketing conditions, and in the elimination of many uneconomic and unfair market practices, demonstrate the effectiveness of the form of control which has been exercised under the war power and the desirability of continuing it or a similar form of supervision. Not only the stockmen who patronize these great centers of live-stock trade, but also some members of the trade themselves, have recognized the possibilities for betterment of marketing conditions through their regulation by the Department, utilizing its corps of supervisors clothed with the requisite authority. Besides the protection thus extended to consignors of live stock for sale at the markets, the opportunity is afforded for improvement in methods, facilities, and trade practices incident to the handling and sale of live stock involving many millions of dollars daily.

Closely associated with the supervision of live-stock markets is the problem of a similar authority over the slaughtering, meat-packing, and related interests which are centered at the principal live-stock markets. Under the regulations applied to meat-packing establishments by the Food Administration, limitations have been placed on profits on meats and by-products handled by these establishments, the installation of uniform accounting systems has progressed with comparative rapidity, and the centralization of control by a small group of packers has been materially checked. The economic welfare of meat production and distribution would be promoted by the continuation and development in some form of the supervision over the packing industry. Such control should be closely coordinated with that over the live-stock markets. There is need, in connection with this supervisory system, of a central office to which packing concerns should be required to report currently in such form and detail that it would be constantly informed concerning their operations. Such an arrangement would afford protection to producers and consumers.

The restoration and maintenance of conditions which will justify confidence in the live-stock markets and meat-packing industry is the greatest single need in the present meat situation in the United States. It seems desirable, therefore, that the necessary legislation be enacted at the earliest possible moment. The assurance of open competition and the stabilizing of prices in the live-stock markets, the elimination of evil practices, the adjustment of charges for market services, and the restoration of confidence in market conditions generally, apparently require three remedies, namely, regulation, information, and voluntary cooperation. Federal regulation, organized and administered as indicated above, exercised in close harmony with the regulatory bodies of the various States, is the most essential feature. Constant publicity, under Government direction, of current market prices, supplies, movements, and other conditions pertaining to the marketing of live stock, meats, and animal by-products, would add immeasurably to the effectiveness of any form of regulation. It would also be a means of stabilizing the marketing of live stock and its products and of making available the information required by producers and distributors for the most intelligent and economical marketing of their products. Progress already has been made in the creation of machinery for such service at market centers

in all parts of the United States. Legislative authority for its further development in connection with live-stock market supervision should be continued and extended. Finally, better organization of live-stock producers and closer cooperation between their organizations and those representing the different classes of intermediaries, all working in harmony with agencies of the Government directly concerned, will also increase the effectiveness of regulation and publicity, make for the maximum of efficiency, and conduce to the welfare of the packers and distributors as well as of the producers and consumers.

FEDERAL FEED AND FERTILIZER LAWS.

At present, in order to secure for the public the benefits of the provisions of the Federal food and drugs act with reference to animal feeds, it is necessary to rely on the appropriate statutes of the different States. These are not uniform, and there are a few States which have no laws that can be invoked. It is believed that it would be wise to have a comprehensive Federal feed law placed upon the statute books, under which the Government could proceed in a uniform manner and secure to consumers adequate protection against misbranded, adulterated, and worthless feeds entering into interstate commerce. It is probable also that similar legislation would be feasible and valuable with reference to fertilizers passing into interstate commerce. It is obvious, of course, that if such laws could be enacted they should result in the protection not only of the consumer but also of the honest manufacturer and distributor.

I am convinced that there is much indiscriminate use of commercial fertilizers in this country and, therefore, much waste of money. This arises from the lack of available satisfactory data. Soils require careful treatment just as does the human body. A number of States have conducted fertilizer experiments over a long period and have obtained and disseminated valuable information. Because of the importance of this matter for the whole Union, I believe that the Federal Government should participate in this work and that an adequate sum should be made available to the Department for co-operative experiments with State institutions.

EMERGENCY PRODUCTION WORK.

As has been indicated, during the last year and a half, under the food-production measure, the activities of the Department have been

greatly expanded in a number of directions. Especially striking has been the development of the extension forces, including the county agents, the control and eradication of animal diseases, and the Market News Services. Many trained men and women have been engaged in these tasks. It is highly desirable that provision should continue for these and other emergency undertakings during the remainder of this fiscal year. Indications from every part of the Union are that the efforts of the agricultural colleges and the Department in emergency directions have been fruitful and are appreciated by the great masses of the farmers.

The question arises also whether it would not be in the national interest to make provision for the continuance of a part of the work, at least, after the end of this fiscal year. The work of the Bureau of Markets, especially through its news services, has been demonstrated to be so useful that, regarding it as of permanent value, I have transferred the emergency estimates for it, in part, to the regular bill. The Nation is now engaged, under the act of May 8, 1914, in developing the agricultural extension service. It would be wise to anticipate the amount that would accrue under this measure by the end of the period 1922 and to make such further provision as may be necessary for the continuance of agents of proved efficiency already on the rolls, as well as to continue the intensive work for the more speedy control and eradication of tuberculosis, hog cholera, and the cattle tick, and other important lines of effort. Expenditures for these activities are investments, and it is simply a question how rapidly the Nation wishes the work to proceed. If the finances of the Nation permit it, I urgently recommend that adequate provision be continued.

RURAL HEALTH AND SANITATION.

Every means should be adopted to see to it that the benefits of modern medicine accrue more largely to the scattered populations of the rural districts. Formerly the urban communities were characteristically the homes of disease. They possessed all the disadvantages of concentration of population without adequate sanitary safeguards. Now no cities and very few of the larger towns are without substantial equipment in the way of drainage, sewage disposal, and hospitals. They have the services of specialists and of trained nurses. Very many of them provide free medical and dental clinics for people of limited means, have their schools inspected, and their

water and milk supplies regularly tested and safeguarded. As a consequence, among the inhabitants of the larger communities the ravages of smallpox, typhoid fever, and malaria have been in large measure controlled. The rural districts still have advantages; but a vast deal remains to be done to control such pests as mosquitoes and the hookworm, to eliminate the sources of typhoid fever, and, even more, to give the country districts the advantages of modern hospitals, nursing, and specialized medical practice.

The economic wastes from insanitary health surroundings and from disease are enormous. It is impossible to estimate their extent. It is even more impossible to assess the amount of existing preventable human misery and unhappiness. The remedy is difficult. Many agencies, some of them private enterprises with large funds, are working for improvement. States and medical societies here and there are contributing, more or less effectively. The extension and improvement of agriculture, including the drainage of lands, the clearing of swamps, and the construction of good roads, make for betterment. The Department of Agriculture, through its home-demonstration service, is giving valuable aid, and the Public Health Service is increasingly extending its functions, especially recently under an appropriation for this purpose of \$150,000. To what extent the further projection of effort is a matter for State or local action remains to be determined, but it seems clear that there should be no cessation of activity until there has been completed in every rural community of the Union an effective sanitary survey and, through the provision of adequate machinery, steps taken to control and eliminate the sources of disease and to provide the necessary modern medical and dental facilities, easily accessible to the mass of the people.

Respectfully,

D. F. HOUSTON,
Secretary of Agriculture.

THE PRESIDENT.

REPORTS OF CHIEFS.

REPORT OF THE CHIEF OF THE WEATHER BUREAU.

UNITED STATES DEPARTMENT OF AGRICULTURE,
WEATHER BUREAU,
Washington, September 28, 1918.

Sir: I have the honor to submit herewith a report of the operations of the Weather Bureau during the fiscal year ended June 30, 1918.

Respectfully,

C. F. MARVIN,
Chief of Bureau.

Hon. D. F. HOUSTON,
Secretary of Agriculture.

WAR CONDITIONS.

War conditions have imposed various difficulties in the conduct of the work of the bureau and have caused numerous changes in its personnel during the fiscal year just closed. The call to military service has been accorded a prompt and general response by Weather Bureau men. Many who were not within the selective draft have eagerly sought opportunity to render useful service and have been released in numerous cases to make their qualifications and training as forecasters and meteorologists of military value. A large proportion of those within the draft are now in active service, and some of these, as yet fortunately only a few, have been called to make the supreme sacrifice of life itself.

At this date 145 commissioned employees are carried on indefinite furlough on account of military service, representing a depletion of fully 25 per cent of the trained force of the bureau. A further loss of 200 occurred during the year on account of resignations, almost without exception on account of inadequate pay and the numerous opportunities in commercial and industrial life for larger salaries and better prospects of advancement.

These consequences are inherent to the fixity of statutory employment rolls and the limitations upon expenditures for salaries characteristic of the appropriations for the Weather Bureau. Many able and efficient employees have left the service because of these conditions, and the filling of vacancies has been necessarily restricted to those willing to accept employment upon the relatively unfavorable terms we must offer. It is hoped that recommendations to be made in the estimates may serve to partially improve these conditions.

While all the important features of the full daily program of Weather Bureau work have been maintained as fully as possible, curtailments have been made in a number of minor ways, and as the consequences of war conditions come to be more fully felt more important limitations of our regular service must doubtless be imposed.

SUMMER TIME LEGISLATION.

The daylight saving law, which makes the hours of business an hour earlier between specified dates in April and October, has imposed a distinct extension of the hours of duty of Weather Bureau men, and otherwise has increased the work at stations. This outcome of the legislation resulted inevitably, because on the one hand it was most undesirable for this year at least to make a double break and discontinuity in the standard series of our regular meteorological observations, which for the last 30 years have uninterruptedly been made at the hours of 8 a. m. and 8 p. m., mean seventy-fifth meridian time. On the other hand, it was equally undesirable and more impracticable to issue our daily bulletins, forecasts, maps, warnings, and crop weather information an hour later in the day than the public had been accustomed to receive the same.

The only escape from one or the other of these consequences lay in preserving the continuity of the old records by continuing to make observations for the record at the same absolute hours as in the past, and making and telegraphing another observation at the same hour as usual by the clock but one hour earlier by actual mean time of the seventy-fifth meridian. This course was ordered and compelled the men to be on duty one hour later in the evening than otherwise, simply to secure the night observation and at least for this year to round out the meteorological record, much of the value of which for all scientific work depends upon its uninterrupted continuity under identical conditions for the longest possible period of time.

The daylight saving scheme has doubtless come to stay, and meteorological services must soon adjust their program of observations and public service in a way that will harmonize the conflicting consequences of the present wide adoption of the so-called daylight-saving plan. The suggestion to this end already considered in England and France, that the time of observation be advanced one hour throughout the year, encounters more serious difficulties in the United States than in western Europe, because of the great range of longitude covered by the system of stations now making simultaneous observations.

WAR ACTIVITIES.

The extensions of the work and cooperation of the bureau with direct reference to military service, inaugurated a year ago and mentioned in the last annual report, have been developed, strengthened, and further extended. The bureau has contributed of its personnel and otherwise aided the Chief Signal Officer through the Science and Research Division in the formation of a meteorological unit which now comprises a considerable number of officers and men on active duty in Europe. Skilled forecasters, in cooperation with French and English meteorologists, receive nightly telegrams containing representative weather reports from the eastern districts of the United States, Canada, and the Atlantic coast. These reports supplement local observations over western Europe and the British Isles. Men of the aerological corps make further local observations with pilot balloons and other special equipment. These agencies, largely directed and operated by Weather Bureau men now in mili-

tary service, supply commanders with every species of meteorological information needed for the most effective work with infantry, airplanes, poison gas, etc.

In the United States the cooperation with the Signal Corps has been intimate and continuous, comprising the special training of meteorologists, first at numerous Weather Bureau stations, and later the detailing of two Weather Bureau men for the purpose of giving full courses in meteorology to a large body of soldiers gathered for this and other purposes at a suitable camp at College Station, Tex.

The activities of the Weather Bureau in connection with the war are briefly summarized as follows:

Furnishes forecasts and warnings—

a. To army cantonments and camps and naval bases.

b. To railroads in connection with handling and transportation of food and other supplies.

Furnishes War and Navy Departments with meteorological instruments.

Supplies meteorological data to the Surgeon General's Office for use in connection with studies of dietetics, camp sanitation, hygiene, and the like.

Makes aerological investigations to secure free-air data for aviation and artillery uses.

Conducts special work with kites to test searchlights at night and as an aid to artillerists in detecting moving objects in the air.

Cooperates with the Signal Corps in training balloonists and enlisted men in meteorological work.

Reports vessels entering and leaving Atlantic, Gulf, and Pacific coast ports.

Transmits naval and military business over its telegraph and cable lines.

Assisted in the organization of gas and flame regiment.

Transferred to War Department, for service in France, meteorological experts and forecasters.

More detailed mention of other important features of this work will be found in the topical presentations which follow.

FORECASTS AND WARNINGS.

FORECAST DISTRIBUTION.

The fixed policy of the bureau to purge, from time to time, its lists of those receiving maps, bulletins, forecast cards, etc., by mail has effected a considerable reduction in the number of telegrams sent and cards delivered, but without, it is thought, materially impairing the value of the service. The vital interests centered in food conservation and production, and the growing appreciation by farmers and agriculturists of the value of the forecasts and warnings of the Weather Bureau have necessitated increased effort to extend the free distribution of such information by telephone, through the cooperation of the rural telephone lines, with considerable success. In one State the forecasts were made available by telephone to one fifth as many subscribers as there were inhabitants in the State, and five-sixths of the post offices received the forecast cards by mail on the day of issue.

TRANSPORTATION OF PERISHABLES.

Because war conditions and the congestion of transportation entailed conservation in every direction, special effort was directed to the effective distribution of shippers' forecasts and the warnings of injurious weather conditions, such as cold waves, frosts, etc. Information received from several sources clearly shows the great value of these warnings and the saving they make possible.

The month of October was notable for the unusually early occurrence of frosts and freezing weather throughout the sugar and truck regions of Louisiana and Texas. It is estimated that advance warnings of these conditions issued from the District Forecast Center at New Orleans during that month saved from destruction nearly one-half of the sugar crop, worth millions of dollars; one-half of the white and sweet potato crops, and large quantities of the small matured vegetable crops in those regions.

Several hundred thousand dollars' worth of truck was saved in southern Florida as a result of cold wave warnings issued in the early part of December, 1917.

Live-stock warnings for the benefit of the cattle and sheep interests were reported as of great value, particularly during the lambing and shearing seasons. One of the warnings of this kind issued in April, 1918, from the San Francisco forecast district center resulted in the protection of over 100,000 new-born lambs and in the postponement of the shearing of great numbers of sheep.

The system for the preparation and distribution of warnings of weather conditions favorable to the inception and spread of forest fires has been considerably improved and extended to include warnings of fire hazard conditions likely to result in damage or loss in connection with crops, stock, other foodstuffs, and all kinds of inflammable war material; and a number of these warnings was issued during the year with beneficial results. A special station has been established at Hampton, Oreg., for the carrying on of investigations in connection with this service.

The exceptionally severe weather of December, 1917, and January and February, 1918, resulted in the issue of an unusually large number of storm warnings and probably a larger number of cold-wave warnings than during any other three months in the history of the bureau. A total of 540 of the former and 1,339 of the latter were issued during this period. Special attention was given to the distribution of these warnings in the interest of conservation of food and fuel.

A new application of special weather forecasts was made during the year in connection with the forecasting of weather conditions favorable to the spraying of fruit trees. This project was carried out in the fruit regions of western New York with considerable success.

TROPICAL STORMS.

Only one tropical storm severe enough to justify the display of hurricane warnings occurred during the year, namely, that of September 22-30, 1917. This moved from the central Caribbean Sea in a general west-northwest direction to a position off the mouth of the Mississippi River, whence it recurved sharply to the northeast and entered the United States near Pensacola, Fla. The center of the track crossed Jamaica and caused great destruction to the banana industry on that island, and also caused great destruction on the Isle of Pines and in western Cuba. Hurricane warnings in advance of the storm were issued to points on the central Gulf coast from New Orleans to Apalachicola and resulted in a great saving in life and property. A barometer reading of 28.51, with a wind velocity of 125 miles per hour, was recorded at Pensacola.

WEST INDIAN AND CARIBBEAN SEA STATIONS.

In the completion of the project for the improvement of the weather service in the West Indies additional stations were established at Castries, St. Lucia, and Puerto Plata; and arrangements made for the securing of reports, when threatening conditions were observed, from St. Croix, Antigua, and Grenada. In cooperation with the Cuban Meteorological Service, special stations, supplied with instrumental equipment by the Weather Bureau, were established at Guane and Santa Cruz del Sur, and arranged for at Nueva Gerona, Isle of Pines. Arrangements were also made for daily reports from the Observatory de Montserrat at Cienfuegos.

VESSEL WEATHER STATIONS AND LIGHTSHIPS.

At the close of the year 40 vessels engaged in coastwise traffic were enlisted as stations to report meteorological conditions at sea by wireless. On account of war conditions, however, very few reports were received. The stations previously established on the lightships at Nantucket Shoals, Fryingpan Shoals, Diamond Shoals, and Heald Bank were discontinued, as it was found too difficult to secure accurate observations, which, moreover, were not of great value owing to the relatively close proximity of the lightships to shore stations.

SUBSTITUTION OF BULLETINS FOR MAPS.

In the interest of conservation of material, card bulletins containing the forecasts, weather summary, and a table of data derived from the daily observations were substituted for the graphic maps with satisfactory results at about 50 stations.

STATIONS AND OBSERVATIONS.

The act making appropriations for the Department of Agriculture made provision for a newly equipped Weather Bureau station at Greenville, S. C. This was duly established and observations were begun.

New Federal buildings were occupied during the year for offices at Charlotte, N. C.; Elkins, W. Va.; Grand Junction, Colo.; and Kalispell, Mont., and the Weather Bureau stations at these points were moved to quarters provided therein from rented offices.

As it was necessary to increase the force at Tatoosh Island and North Head, Wash., to cooperate better with the Naval Coast Patrol, temporary residence buildings were provided at these stations for the use of assistant observers.

It having been found practicable to utilize a frame office building formerly occupied at the discontinued Port Crescent, Wash., station, this building was taken down, removed to Port Angeles, and re-erected on a lot owned by the Weather Bureau, of which legal possession had finally been secured after several years of litigation. This enabled the bureau to move out of rented quarters previously occupied at Port Angeles and effect a considerable saving in rental.

Permanent title having been secured to the reservation occupied by the Weather Bureau station at Bismarck, N. Dak., since June 1, 1894, action was taken during the year to move the residence build-

ing thereon to face on Main Street, and effect greatly needed permanent improvement in the equipment at that station.

An acceptable bid was finally secured for the construction of a new telegraph office and observatory building at Cape Henry, Va., authorized by Congress in 1917. This building will be completed within the appropriation therefor and be ready for occupancy in September, 1918.

The status of the Independence, Cal., station was changed from that of a special meteorological to a fully equipped station, occupying rented quarters.

AEROLOGICAL INVESTIGATIONS.

During the year considerable enlargement in the aerological work of the Weather Bureau was effected, under the provisions of an item in the Army bill, which reads as follows:

For the establishment and maintenance by the Weather Bureau of additional aerological stations for observing, measuring, and investigating atmospheric phenomena in aid of aeronautics, including salaries, travel, and other expenses in the city of Washington and elsewhere, \$100,000, to be expended under the direction of the Secretary of Agriculture.

In accordance with this act, sites for aerological stations in addition to the one already established at Drexel, near Washington, Nebr., have been selected at Broken Arrow, Okla., Ellendale, N. Dak., Groesbeck, Tex., Leesburg, Ga., and Royal Center, Ind. This distribution is as favorable as possible with the limited number of stations to secure observations of free air conditions over a large portion of the country. Installation of equipment has been completed at the Ellendale station, and free air observations were begun in December, 1917. The other four stations are being equipped as rapidly as the difficulties of obtaining suitable apparatus permit. Surface meteorological observations are already being made at each of the stations.

Free air observations, by means of kites, were continued at the Drexel Aerological Station during the entire year, and have been obtained at the Ellendale Aerological Station since December 17, 1917. The data thus obtained include observations of atmospheric pressure, temperature, humidity, wind direction and velocity, cloud altitude and movement, and, at Drexel, electric potential. Daily telegraphic reports of conditions at one or more selected levels were sent to the forecast center of the Bureau at Washington, D. C., on all days when flights were made. At Drexel, in addition to the daily flights, series of observations covering a period of about 30 hours were made whenever conditions were favorable. The data thus obtained enable the bureau to follow in considerable detail the diurnal changes at different altitudes. In all, 478 observations were made from July 1, 1917, to June 30, 1918. Of these, 134 were made in 18 different series, the remaining 344 being made as daily observations. The average altitude reached in all flights was about 3,000 meters. At Ellendale 163 flights were made from December 17, 1917, to June 30, 1918, the mean altitude being about 2,400 meters.

The free air data obtained at Drexel from April to December, 1916, inclusive, were published in Supplements 7 and 8 (Aerology Nos. 3 and 4) of the Monthly Weather Review; those obtained dur-

ing 1917 have been sent to the printer: those during the first half of 1918 have been reduced and will shortly be ready for publication. In addition, considerable work has been done in the preparation of a summary based on all free air data thus far obtained at Drexel.

In its purpose to render the greatest possible assistance in the vigorous and successful prosecution of the war, the bureau has co-operated with various branches of the United States Army in the following ways:

1. Papers on "Meteorology and Aeronautics," "Mean Values of Free Air Barometric and Vapor Pressures, Temperatures and Densities over the United States," and "The Turning of Winds with Altitude" were prepared and published and copies have been furnished for the information and use of the Aviation and Artillery Services.

2. Information relative to free air conditions at certain specified times in this country and in different parts of Europe has been furnished whenever requested.

3. Instrumental equipment, including kite meteorographs, has been supplied for the use of the American Expeditionary Forces and the training camps in this country.

4. In connection with special experimental tests, temporary field stations have been established and kite flights made at Ellington Field, Tex., Potomac Park, Washington, D. C., and Aberdeen Proving Grounds, Md.

WORK IN CLIMATOLOGY.

The regular climatological work of the Bureau was carried forward during the year by the large corps of cooperative observers as usual. Many changes occurred during the year in the observing force, arising largely from the necessities attending the war. Some of the younger observers have responded to the call for military service, and others have voluntarily assumed lines of war work which have either required their absence from home or taken up their time to such an extent as to interfere with the observations. Despite the added duties arising out of the war it is gratifying to note a constant improvement in the character of the observations furnished. The promptness of the observers in forwarding their monthly reports is deserving of the highest commendation.

No material effort has been made during the year to increase the number of stations, but rather to effect a more satisfactory distribution, improve their equipment, and secure better reports.

Cordial cooperation continues between the Weather Bureau and other branches of the Government, and reporting stations, under the supervision of employees of these bureaus, have been established in regions where it would be impossible to secure other observers. This is particularly true as regards the Forest, Indian, and Reclamation Services, whose employees have given valuable reports from otherwise inaccessible regions, mostly in the high mountains of the West.

The policy of more frequent inspection of cooperative stations inaugurated recently has continued, and the beneficial results became at once apparent. This has been especially noticeable in the Alaska section, which has only lately been reorganized and put upon a basis

similar to that existing in the States. Practically all the stations in the Territory were visited during the year, and reports are now being received with much more regularity and in greater number than previously.

OCEAN METEOROLOGY.

In general the work of the Marine Section has progressed along the usual lines. The war has still further reduced the number of vessel weather reports received from the north Atlantic Ocean, but the number of reports from the north Pacific continues to increase, though slowly. A considerable number of reports, largely from the north Atlantic Ocean, are being withheld by the naval and military authorities until after the war. The work of charting reports from the north Pacific Ocean, begun last year, is proceeding.

The extensive ship-building program on which the United States has embarked creates an increased need for more complete knowledge of weather conditions over the seas, and when peace again prevails ocean meteorology will claim far greater attention on the part of the Weather Bureau than ever before. Evidence of this is indicated by the increasing number of requests for information respecting weather conditions at sea received by the Bureau during the year.

The publication in the Weather Review of the monthly summaries of weather conditions over the north Atlantic Ocean, together with charts showing the averages of pressure and temperature, the prevailing direction of the winds, and the paths of the more important storms, has continued.

DATA AND INFORMATION SUPPLIED.

Many extra demands for data, resulting from the war, have come from the several Government departments, particularly from the Aviation and Medical sections of the War Department, which have required extensive computations of climatic data for consideration in determining the location of flying fields, sites for hospitals, etc.

TELEGRAPH SERVICE.

Notwithstanding the serious strain imposed upon the telegraph and telephone systems by war conditions, transmission of Weather Bureau circuit reports, forecasts, and miscellaneous telegrams has been accomplished, as a rule, without detriment to the public service. Approximately 170 station reports, including their reciprocal distribution over 21 circuits, represent the transmission of 4,500 reports twice daily, totaling over 3,000,000 code words annually. The operation of this system in conjunction with the dispatch of a limited number of special messages daily places in the hands of the public in every section of the country full knowledge of the weather conditions over practically the entire United States and adjoining territory at comparatively small cost.

By arrangement with the Western Union Telegraph Co. the preparation of the monthly bills of that company has been materially expedited by the use of telegraph division forms for that purpose. Examination of all telegraph and telephone accounts presented by

about 70 different companies, involving an expense of approximately \$250,000 per annum, is made by the employees of this division. Settlement has followed closely upon their presentation.

The division pamphlet, Instructions to Operators on the Weather Bureau Telegraph and Telephone Lines, has been completely revised during the year, the last previous revision having been made in the year 1906.

WEATHER BUREAU TELEGRAPH AND TELEPHONE LINES.

Detailed statements and descriptions of the several telephone and telegraph lines maintained by this bureau were submitted in the report for last year and need not be repeated here as no changes of material consequence claim attention.

RIVER AND FLOOD SERVICE.

The flood warning service has been maintained without appreciable change, although for obvious reasons retrenchments have been made whenever practicable. Fortunately no serious floods occurred in any part of the country, yet one of the most serious ice gorges of which there is a record formed in the early part of the winter in the Ohio River below Cincinnati and held continuously for 58 days. This gorge so reduced the cross section of the stream that when the ice in the upper tributaries broke up and the flood waters came down a lake or pool formed, extending about 100 miles upstream. At one time the surface of this pool was higher than the river below the gorge by about 25 feet, thus creating a situation of the utmost gravity along the lower river. When the gorge finally broke, river craft moored for the winter in sheltered places suffered great losses, aggregating approximately \$3,000,000. Coming at a time when replacement is extremely difficult, such a loss must seriously retard the growth of river transportation for several years.

INSPECTIONS.

The absence of serious floods gave the field officials of the bureau a much needed opportunity of inspecting gaging stations and of making the necessary repairs to the equipment. During the year 93 stations were inspected and repairs were made or were in progress at the close of the year.

SNOW MEASUREMENTS.

Measurements of snow depth at high level stations in the West were made at 147 stations, being a decrease of 18 as compared with the previous year. Intensive snow surveys were necessarily abandoned except on the high levels of the watershed that supplies the Roosevelt Reservoir of Arizona.

PRECIPITATION IN MOUNTAINS OF LOS ANGELES AND SAN BERNARDINO COUNTIES OF CALIFORNIA.

The project of determining the amount of precipitation in the mountains of Los Angeles and San Bernardino Counties, Cal., has been carried on at 51 stations, an increase of 32 during the year, in cooperation with the United States Forest Service of the department, the United States Geological Survey and the counties above named, and without cost to the bureau except for apparatus.

The Wagon Wheel Gap Experiment Station has also been continued. This station is maintained in cooperation with the Forest Service of the department as in former years. Since the first phase of the experiment is drawing to a close, arrangements have been made looking to a discussion of the meteorological data that have been accumulated in the last seven years.

PRINTING AND PUBLICATIONS.

The utmost economy was practiced throughout the year in the issue of publications and in the purchase of the necessary supplies of paper, ink, and other printing materials. Nevertheless, the usual series of periodical and nonperiodical publications have been adjusted to war conditions and issued much as usual, including some new publications which have more or less definite relations to war work.

A careful revision of mailing lists justified dropping the names of a number of recipients of periodical publications whose interest in the same ceased to be active for one reason or another.

Large and frequent demands were made for such Weather Bureau pamphlets, reprints, etc., as are of value in military instruction and practice, especially in aviation, and these were promptly and liberally filled to the extent of our resources. The requests were made not only officially by bureau chiefs, commanding officers, and instructors, but also in large numbers by individual officers and enlisted men stationed at the various camps throughout the country.

Since the beginning of the war the distribution of publications to foreign addresses by mail and international exchange has gradually been reduced to a comparatively small number of copies. At present the service is discontinued to all the central powers and their allies, and to countries wholly or in part occupied by them. A limited reserve of the more important publications is maintained in our stock for supplying authorized foreign demands after the cessation of the war.

All the material for the Monthly Weather Review was prepared and submitted on schedule time, and the data for the Annual Report of the Chief of Bureau, 1916-17, were collected, compiled, and the volume issued at the time prescribed by law. Considerable data regarding the occurrence of tornadoes and hail storms were collected, and the text, indicating some of the details of these storms, together with appropriate charts showing their distribution throughout the country, form valuable additions to the report.

The monthly and annual summaries of the State climatological services were prepared along the usual lines, and with a few exceptions were issued on schedule time. The printing of a climatic summary for Alaska, similar to those for the States, began with January, 1917, and most of the issues for that year have been printed. It is probable this work will soon be brought up to date.

No material changes were made in the snow and ice bulletins issued last winter at the central office, or for the mountain States of the West, except that a few additional reports have been provided for in some of the higher mountains where observers have not heretofore been available.

A short report on the climate of France and Belgium was prepared during the year, and by publication in the *Weather Review* and the monthly summaries of the State climatological services received an unusually wide distribution.

The preparation of data for the atlas of American agriculture was carried forward to near completion. The text sections on temperature and miscellaneous data were completed, as well as the major part of the necessary drafting work, and some of the folios have been printed and will soon be available for distribution.

In response to the needs of aviators and other students of the atmosphere, an effort has been made to bring together as much as practicable of the important knowledge of the physics of the air. The publication of this without cost to the Government was begun as a serial in the *Journal of the Franklin Institute*, August, 1917, and continued through the year.

In cooperation with the Smithsonian Institution, the Smithsonian meteorological tables have been extensively revised by officials of the Weather Bureau and republished by the Smithsonian Institution.

Considerable progress has been made on a paper discussing the more important weather features attending the severe cold of last winter. It was expected that this would be completed before the end of the fiscal year, but it has been delayed by press of routine work and failure so far to receive reports from some far northern districts.

LIBRARY.

During the year, 827 books and pamphlets were added to the library, the same number as last year. The total strength of the collection is now about 37,100. The library has been utilized extensively by men undergoing training for the meteorological work of the Army and the Navy and has lent a considerable number of books for use at the front. A brief bibliography was prepared on the subject of military meteorology.

The number of promotion examination papers rated during the year was 32, of which 28, or 87 per cent, received passing grades. The promotion examinations, which, with some variations in form and scope, have been in operation since 1899, were discontinued May 4, 1918. This course does not imply any lowering of the standards of qualifications for entrance or eligibility for advancement, but rather the reverse, because a new entrance grade has been established, examinations for which are held as frequently as necessary by the Civil Service Commission.

SEISMOLOGICAL INVESTIGATIONS.

The systematic work of collecting and publishing earthquake data, begun December 1, 1914, was continued during the year. These data are of two kinds—noninstrumental reports of earthquakes felt and instrumental records, often of quakes wholly imperceptible to the senses. The noninstrumental reports are rendered by all the regular stations of the bureau, nearly 200 in number, and also by nearly all the bureau's 4,500 cooperative observers. The instrumental records published by the bureau have been obtained in part by instruments

owned and operated by the bureau itself, one at Washington, D. C., the other at Northfield, Vt. The remainder are furnished through cooperation with various agencies at 18 additional stations distributed from Panama to Alaska and from the Hawaiian Islands to Porto Rico.

During the calendar year 1917, 112 earthquakes were felt within the borders of the United States proper. The great majority of these produced no damage whatever, and none any material damage.

SOLAR RADIATION INVESTIGATIONS.

Continuous records of the total amount of radiation received on a horizontal surface from the sun and sky were obtained throughout the year at Washington, D. C., Madison, Wis., and Lincoln, Nebr. Measurements of the intensity of direct solar radiation have been made at the above stations, and also at Santa Fe, N. Mex., whenever atmospheric conditions have been suitable, and at Washington and Madison the percentage of polarization of sky light has been measured. A monthly summary of the results has been published in the Monthly Weather Review.

Experience has shown the superiority of the silver-block type of Marvin pyrheliometer over the spiral-ribbon type. Two new instruments of the former type have therefore been constructed and standardized during the year to replace instruments of the spiral-ribbon type in use at Lincoln and Madison. A similar change in the instrumental equipment has also been made at Santa Fe, so that all four pyrheliometric stations are now equipped with the new and improved form of Marvin pyrheliometer.

Persistent requests have been received from various sources for the cooperation of the Weather Bureau in a project having for its object the determination of sky brightness, or the intensity of natural lighting, in various sections of the United States, at different seasons of the year and hours of the day, and under various atmospheric conditions. Some preliminary work has been done along this line.

A program for meteorological observations was planned for about 55 Weather Bureau stations in or near the path of total obscuration of the sun during the eclipse of June 8, 1918. In addition, a special station for measuring both incoming and outgoing radiation during the eclipse was established at Goldendale, Wash., at the center of the path of totality. The complete program was carried out as planned, although weather conditions at some points were unfavorable.

The Office of Solar Radiation Investigations at Camp American University has cooperated with the experiment station of the Bureau of Mines (now the Chemical Warfare Service, National Army) in determining the prevailing meteorological conditions during experiments in the open air.

AGRICULTURAL METEOROLOGY.

With the growth and extension of the service rendered by the Weather Bureau and represented by its great weather and crop service, the establishment of the Division of Agricultural Meteorology to handle all such work under capable direction was the natural outcome. This organization became effective February 21, 1916, and has

been described in previous reports. Its activities have been continued, improved, extended, and given specially direct application as far as possible to all agricultural activities of the Nation now so directly concerned in food production and conservation.

In addition to its function of supervising and directing the weather and crop service, this division is also responsible for conducting studies of many different kinds. Without attempting to describe the various special investigations comprised within the operations of this division, the following brief outline will indicate the extent and character of its activities:

CORN AND WHEAT REGION SERVICE.—Covers 16 principal grain States, with the region center at Chicago, Ill., and 188 special reporting stations.

COTTON REGION SERVICE.—Covers 11 principal cotton States, with the region center at New Orleans, La., and 165 special reporting stations.

SUGAR AND RICE REGION SERVICE.—Covers the rice and sugar cane growing sections of the South, with 6 special-reporting stations.

CATTLE-REGION SERVICE.—Covers all or parts of eight grazing States, with 67 special-reporting stations. This service was changed in the spring of 1918 from a daily service during the summer months to a weekly service throughout the year. This change is proving to be of decided advantage.

SPECIAL FORECAST AND WARNING SERVICES.—Special stations are maintained in the principal tobacco, potato, alfalfa seed, cranberry, citrus, and deciduous fruit-growing regions, to aid in special forecasts and minimum temperature warnings, and have proved to be of marked value in this connection.

COOPERATION.—The Weather Bureau is cooperating with other bureaus and departments in maintaining special stations for the benefit of science and agriculture. Such stations are maintained in 14 different States.

PROTECTION OF ORCHARD AND TRUCK CROPS FROM FROST.—Considerable time has been devoted to the making of temperature and air-drainage surveys in citrus and deciduous orchards in the West, and in studying orchard-heating problems. Officials of the bureau have been placed in the principal districts where orchard heating is extensively practiced to aid in making and distributing minimum temperature forecasts.

FROST STUDIES IN NORTH CAROLINA.—For several years the bureau has been conducting frost and temperature studies in North Carolina. During the year the final report of the discussion of nearly five years' accumulated data was submitted and is undergoing careful examination and consideration with the view to ultimate publication.

THE EFFECT OF THE WEATHER UPON CROPS.—The Division of Agricultural Meteorology has continued its study of the relation between weather and climate, and crops. Data have been collected and tabulated and results obtained which are proving of marked advantage to agriculture.

THE NATIONAL WEATHER AND CROP BULLETIN.—The preparation and issue of this bulletin continue to take the greater part of the time of the force of this division during the crop season. It is published weekly from April to September, inclusive, and monthly during the winter season. A new feature during the past season has been the inclusion of data regarding the planting and harvesting of the principal crops, at the request of the Office of Farm Management, as an aid in determining the labor requirements. The results of the correlation of weather and crops have been published in this bulletin from time to time.

PACIFIC COAST WEATHER AND CROP SERVICE.—A special weather and crop service covering the States of Arizona, Utah, Nevada, Idaho, Washington, Oregon, and California, was inaugurated at the beginning of the 1918 crop-growing season, with San Francisco as the district center. A bulletin somewhat similar to the National Weather and Crop Bulletin was issued at the district center each Wednesday from April to September, inclusive, and will be continued monthly during the winter season.

INSTRUMENTATION, TESTS, AND REPAIRS.

The closing of European markets for scientific apparatus, accompanied by the great congestion of manufacturing work in this country, has presented serious difficulties to the Weather Bureau in procuring the necessary high-grade instruments for its work and has imposed upon what was formerly known as the instrument division of the bureau many additional duties, since it became necessary in certain respects at least to undertake to construct here instruments which could not possibly be procured elsewhere. In fact, we have with limited facilities endeavored to extend aid to the Army and Navy in constructing meteorological instruments to meet special needs. Under these conditions it became necessary to reorganize this part of the work of the bureau and to divide the original instrument division into two parts, one devoted to general administrative affairs connected with the receipt and issue of instruments and their exposure at stations, the other to be concerned with the testing of new instruments, the construction and repair of instruments, and their careful adjustment to meet station requirements. Even at best the difficulty of maintaining necessary supplies to meet all needs has been serious, and more or less delay has necessarily marked the progress of this part of our work. As time goes on and as American manufacturing interests become more able to meet requirements which in many cases formerly were supplied from European sources, a general improvement must result.

REPORT OF THE CHIEF OF THE BUREAU OF ANIMAL INDUSTRY.

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF ANIMAL INDUSTRY,
Washington, D. C., September 28, 1918.

SIR: I have the honor to transmit herewith a report of the operations of the Bureau of Animal Industry for the fiscal year ended June 30, 1918.

Dr. Alonzo D. Melvin, chief of the bureau since 1905, died December 7, 1917, and the undersigned succeeded to the position December 10. In Dr. Melvin's death the bureau and the department sustained a severe loss. A sketch of his life and work and a tribute to his memory appeared in the Service and Regulatory Announcements of the bureau for November, 1917.

Respectfully,

JOHN R. MOHLER,
Chief of Bureau.

Hon. D. F. HOUSTON,
Secretary of Agriculture.

WAR ACTIVITIES.

INCREASE IN ANIMAL PRODUCTS.

In striving to do its part in meeting war conditions the Bureau of Animal Industry has concentrated its energies on increasing the yield of animal products needed for food and clothing. The main object of the year's work has been to bring about the production of more beef, more pork, more mutton, more poultry and eggs, more milk, butter, and cheese, and more hides, wool, and fats. The work has been such as to emphasize especially the fundamental principles of live-stock production and to promote better methods of breeding, feeding, and caring for farm animals and the constructive development of the live-stock industry, while at the same time continuing the necessary police and sanitary service provided for by law.

The efforts to stimulate production have been directed along two principal lines: First, through meetings, news articles, bulletins, pamphlets, etc., to encourage the live-stock raiser to increase his herds and flocks and the yield derived from them; second, assisting the stock raiser to conserve his live stock after it has been produced by aiding him in keeping his herds and flocks from being decimated by disease.

Much of this work was made possible by the congressional appropriation in the food production act, and much of it has been carried out in cooperation with State authorities, agricultural colleges, and other agencies.

PIGS AND POULTRY.

Especially fruitful results have been obtained in increasing the production of pigs and poultry. The campaign for pork production was planned for an increase of 15 per cent in 1918 over 1917, to meet the needs as estimated by the Food Administration. Activities in the fall of 1917 were designed to stimulate the increased breeding of sows, while during the spring of 1918 efforts were made to save as high a proportion of the young pigs as possible. The response has been good and conditions favorable, and while full and accurate returns for the calendar year are not yet available, the indications are that the desired increase will be realized, at least in weight if not in numbers.

The poultry campaign reached every part of the country and already has brought large results. The slogans "Hatch Your Chickens Early" and "One Hundred Hens on Every Farm, One Hundred Eggs from Every Hen" have been followed to a noticeable extent. The same is true of the appeals to people in towns and cities to keep small back-yard flocks, thereby utilizing table scraps for the production of poultry and eggs for home consumption. People also have been urged to preserve eggs during the season of plenty, to be consumed in time of scarcity, and printed directions for preserving eggs in water-glass solution and in limewater were widely circulated. It is known that enormous quantities of eggs have been preserved in these ways. Other features of the poultry campaign were the advocacy of the production of infertile eggs to avoid losses from spoilage, and of the early marketing of surplus cockerels so as to promote the production of infertile eggs and the conservation of grain. Poultry raisers have been advised also to give more attention to the quality, breeding, and selection of fowls and to grow as much poultry feed for their own use as possible. The eating of more poultry and eggs has been encouraged so as to reduce meat consumption and release a larger quantity of meat for shipment overseas.

In the pork and poultry increases the boys' and girls' pig and poultry clubs have had a creditable share.

BEEF CATTLE AND SHEEP.

For the production of beef, stockmen in all parts of the country have been urged to carry sufficient numbers of cattle to make the fullest possible use of pastures and roughages that otherwise would go to waste. Cattle feeders have been shown how to save grain for human consumption by substituting other feeds for their stock. Assistance was given in the transfer of about 150,000 cattle from drought-stricken areas in Texas to States lying to the east, where feed was plentiful. Efforts have been continued to bring about the raising of more cattle in the areas freed from ticks.

Sheep husbandry was included in the program for increased production. The emergency work has consisted in arousing greater interest in sheep raising, giving assistance to prospective raisers in obtaining satisfactory stock and equipment, discouraging the slaughter of useful breeding ewes, and assisting farmers in preparing their wool for market.

COMBATING ANIMAL DISEASES.

The efforts to induce increased production of live stock are closely related to the control and suppression of animal diseases. In the past our farmers have suffered with equanimity losses that from a national point of view are now more serious than ever before, and the bureau has taken more energetic efforts than ever to reduce these losses. The normal work in that direction has been greatly enlarged and quickened.

The eradication of southern cattle ticks has been pressed vigorously, with the result that the area released from quarantine in the last fiscal year is the largest released in any one year since the work was begun, in 1906. Territory amounting to 67,308 square miles in 10 Southern States was released during the year because of having been freed of ticks, making a total of 379,312 square miles since the beginning, or 52 per cent of the original quarantined area. With the release of the entire State of Mississippi from quarantine in December, 1917, a wedge of free territory has been forced through to the Gulf of Mexico. The method of eradication consists in the systematic and regular dipping, in a standard arsenical solution, of all cattle in a community, throughout the season. The cost of tick eradication has been found to be from 18 to 50 cents a head of cattle, while the enhanced value of each animal is greatly in excess of this, one canvass having shown an estimated average increase of \$9.76. The eradication of the ticks is not only overcoming heavy losses but permits the raising of high-class beef cattle and the development of dairying in sections where neither of these industries could be successful while the ticks remained.

In all the tick-infested States the work of tick eradication has reached a point where local option in the matter has ceased to be effectual. Unfortunately in certain counties the voters and county officials remain inflexible in their refusal to accept Federal or State cooperation. This condition can be overcome only by specific State legislation requiring county authorities to provide by a certain date sufficient dipping vats and dipping materials and requiring that all cattle in the county shall be dipped under Federal or State supervision every 14 days for 8 months, beginning in April, and that State quarantine regulations be strictly enforced. Such legislation has resulted in the freeing of 31 counties in Mississippi and the release of the entire State from quarantine. A similar State law is being enforced in 42 parishes in Louisiana this year, and in 1919 a law of the same character will become effective in 65 counties in Texas. The enactment of similar laws is under consideration in other States. Such measures promise to hasten greatly the completion of the work.

Hog cholera is undoubtedly the greatest impediment to increasing our hog production. The present methods of control by farm sanitation, quarantine, and the application of antihog-cholera serum have met with marked success in reducing and preventing the disease. The emergency appropriation enabled the bureau to extend its cooperation to 33 States. Data compiled by the department show that the losses from hog cholera in 1914 amounted to \$75,000,000, while for the year ended March 31, 1918, they were but \$32,000,000, a reduction of more than 50 per cent in less than five years.

Reports from inspectors indicate that there has been a further reduction since the last estimate. Stated in another way, the country-wide death rate from hog cholera in 1917 was but 42 per 1,000, the lowest in 35 years and a wonderful contrast to the 144 per 1,000 in 1897 and 118 per 1,000 in 1914.

The protective serum has been used at public stockyards during the last year in a way to increase the output of pork. It often happens that a farmer ships his hogs to market when they are not ready for slaughter, because hog cholera has appeared in the neighborhood, or for some other reason. Formerly it was customary to slaughter all hogs promptly after their arrival at public stockyards, whether they were in fit condition for slaughter or not, since such yards were usually infected with cholera, and there was danger that if pigs were shipped from the yards to farms for further growth and fattening they would soon contract the disease and die, besides infecting other hogs on the farm. It is now the practice to treat these immature pigs with serum in the stockyards and send them to farms where they are fed and allowed to reach maturity and a proper degree of fatness. After that they are shipped back to market and yield many more pounds of pork and lard than if they had been slaughtered in the first instance. This considerable saving has been made possible by the bureau's supervision of the commercial preparation of serum under the law, thus making available a sufficient supply of reliable serum. Only serum produced by licensed establishments is used at the stockyards.

Tuberculosis, the most widely distributed destructive disease that now menaces the live-stock industry, recently has been made a special object of attack. In cooperation with State authorities and live-stock owners a campaign has been undertaken in 40 States along three lines—namely, the eradication of tuberculosis from herds of pure-bred cattle, the eradication of tuberculosis from circumscribed areas, and the eradication of tuberculosis from swine. In the beginning the efforts are being concentrated on the first project, since the pure-bred herds are the foundation of our breeding stock. A plan which was adopted in December, 1917, by the United States Live-Stock Sanitary Association and by representatives of breeders' associations and approved by the Bureau of Animal Industry has been put into operation with the cooperation of a large number of herd owners. With the consent of owners, the herds are tested with tuberculin, and any diseased animals found are removed and the premises cleaned and disinfected. Subsequent tests are made at proper intervals. By this means there is being established a list of pure-bred herds from which persons may buy breeding stock with reasonable assurance that it is free from tuberculosis. The first accredited list, consisting of more than 200 names of owners of herds of pure-bred cattle, representing tests made up to the end of the fiscal year, has been compiled and printed for distribution to breeders. The list also contains 900 additional herds that have passed one successful test, but they must pass another annual test before becoming accredited.

Heavy losses of horses have resulted from influenza or shipping fever, especially among animals collected and shipped for war purposes. Since the United States entered the war, the bureau has

extended its cooperation to the War Department and to State and local authorities at assembling and shipping points, with a view to minimizing the losses following exposure to this disease. Horses are inspected for influenza, those found affected are segregated, and the barns, stables, corrals, cars, etc., used in handling them are cleaned and disinfected. Though this work is yet in its incipiency, sufficient progress has been made to show that the losses resulting from this disease can be greatly reduced.

Larger forces and greater efforts have brought further progress in the eradication of the parasitic diseases known as scabies of sheep and cattle. These diseases now linger in only a few small portions of the country. Greater efforts have been put forth, also, to control, reduce, and prevent blackleg, anthrax, hemorrhagic septicemia, contagious abortion, dourine, parasites, plant poisoning, and other causes which operate to reduce live-stock production.

DAIRY PRODUCTS.

As the dairy industry of the United States is being called upon more and more to shoulder the burden of supplying the world's needs for dairy products, the bureau has endeavored to bring about an increase in the output by means of more and better cows, better methods and practices, and the extension of the industry. Special efforts have been made to maintain and, if possible, to increase the size of dairy herds. The consuming public has been impressed with the vital properties of milk and its products, and has responded heartily to appeals to use dairy products well and wisely but without waste. Continued encouragement has been given to the development of the dairy industry in the South and in the West and to the organization and operation of cheese factories in the mountainous regions of the South. The building of silos has been promoted as a means of providing succulent winter feed for dairy cows and other live stock.

Special attention has been given to the fuller utilization, for human food, of skim milk and buttermilk, large quantities of which ordinarily are fed to live stock or wasted. The high food value of dairy by-products has been emphasized alike in the city and on the farms. Printed matter pointing out the value of cottage cheese as a food and telling how to make it has been issued in large editions and widely circulated. Specialists have been sent out in cooperation with State extension organizations to encourage the production and consumption of cottage cheese and to demonstrate how it is made and the various ways in which it may be used satisfactorily as a meat substitute. This work has led to the greater consumption of cottage cheese and the release of quantities of meat for shipment overseas.

WHOLESOME FOOD FOR MILITARY AND NAVAL FORCES.

The bureau has cooperated to the fullest extent with the War and Navy Departments in providing our military and naval forces with an abundant supply of good food and in protecting them against unwholesome products. The Federal meat inspection, which for years has protected the civil population of the United States from bad meat in interstate commerce, has now been extended to include

the special supervision of the meat supply of the American Army, Navy, and Marine Corps.

The inspection, selection, and handling of meats and fats are in expert hands from the time the live animals are driven to the shambles until the finished product is delivered in good condition to the mess cooks. Inspectors have been assigned to the various cantonments, training camps, forts, posts, and other places in the United States where large numbers of troops are assembled. There are 69 Bureau of Animal Industry inspectors with the Army and 30 with the Navy.

In cooperation with the Public Health Service assistance has been given in obtaining supplies of wholesome milk for Army and Navy establishments. As in the past, the manufacture of butter for the Navy has been supervised, the quantity inspected last year being more than four times the ordinary peace requirement. The inspection of food for the Navy has included also poultry, fish, oysters, clams, eggs, and cheese.

OTHER WAR ACTIVITIES.

In other ways the bureau has given its aid in the prosecution of the war. The War Department has been supplied monthly with 300,000 to 400,000 doses of mallein for testing horses for glanders. The cooperative work with the War Department in producing horses for the Army by the use of the bureau's stallions has been continued. Studies have been made with a view to the saving of sugar, saltpeter, and salt in the curing of meat and to procuring substitutes for edible lard oil for industrial use. Efforts have been made to increase the leather supply by urging greater care in the skinning and curing of hides. Various articles found in stockyards and other places have been analyzed or otherwise examined to determine whether they were infectious or carried poisonous substances. The importation of cattle from Central America, Mexico, and adjacent islands has been supervised to guard against the introduction of diseases while adding to our meat supply.

Three hundred and twenty-five of the bureau's employees have entered the military service. Many of them have gone into the veterinary and sanitary corps, and others have become artillery, cavalry, infantry, or naval officers. A much larger number have resigned to accept more lucrative employment in the industrial world. These losses have handicapped the bureau's work, yet the zealous and faithful services of those who have remained, with the addition of about 2,100 new members to the force, have made it possible to meet the increased duties.

LITERATURE

During the fiscal year 95 new publications, comprising 1,753 printed pages, were issued or contributed by the bureau. These publications include 19 department bulletins, 24 Farmers' Bulletins, 7 articles in the Journal of Agricultural Research, 7 articles for the Department Yearbook, 13 issues of Service and Regulatory Announcements, 25 miscellaneous pamphlets, and 26 orders in the nature of regulations. In addition 90 articles were furnished for the Weekly News Letter and other information service of the department and 37 were contributed to agricultural, scientific, and technical journals.

REPORTS BY DIVISIONS.

Besides the activities having a direct bearing on the war situation, as already outlined, the bureau has managed to continue its regular work, though in some instances in a somewhat curtailed form. The year's work as carried on through the various divisions of the bureau's organization is presented more fully in the following pages.

ANIMAL HUSBANDRY DIVISION.

The Animal Husbandry Division, under George M. Rommel, chief, has given special attention to stimulating the production of live stock and poultry and saving cattle from regions affected by drought.

SAVING DROUGHT-STRICKEN CATTLE.

In June, 1917, drought conditions in Texas became so bad that large numbers of cows and heifers were being sent to market for slaughter. After conference between officers of the Bureau of Animal Industry and of the States Relations Service it was decided to place an agent in the field to visit agricultural colleges and interested persons throughout the Southeastern States and call their attention to the Texas situation and the opportunity to save some of the drought-stricken cattle. At the same time another man was placed at Fort Worth, in the office of the Cattle Raisers' Association of Texas, to urge cattlemen not to sell their cattle for slaughter but to hold them for the prospective purchasers from the East. Prospective purchasers were assisted in finding desirable cattle. The State live-stock sanitary boards cooperated by relaxing their sanitary regulations so far as the laws allowed. The agricultural colleges took hold of the movement, especially in the Gulf and South Atlantic States.

As a result of these efforts approximately 150,000 cattle were moved into Louisiana, Arkansas, and States eastward, some going as far as Georgia and Florida. Limited transportation facilities and high freight rates prevented a very much heavier movement. The cost to the department was \$9,739.17, or less than 8 cents a head.

The great majority of the cattle were cows and heifers, and practically all of them were bought outright. These purchases have given farmers in the cotton belt a start of from 5 to 10 years in cattle breeding above what would have been possible by breeding up from native stock. While there were some losses among the cattle which were moved into the Southeastern States, on the whole they came through the winter in good condition.

An important secondary feature of this cattle movement was that it directed the attention of the Texas ranchmen to the Southeast as an outlet. Hitherto in times of stress the Texas producer has always looked north and west for his outlet. Now he has learned that there are large areas east of him which are valuable for cattle production and to which he can send his cattle in large numbers if drought makes it necessary.

PORK PRODUCTION.

Two plans were used in organizing the pork-production campaign, which was conducted in cooperation with the agricultural colleges. In the corn belt emphasis was placed on the necessity for directly

increasing production, with the organization of pig clubs as an incidental means to this end. In the Southern States emphasis was placed on pig-club organization as the major feature, with the appeal for increased production as secondary.

After consultation with Food Administration officials a call for an increase of 15 per cent in the number of brood sows bred in the fall of 1917 over those bred in 1916 was decided upon. This increase was allotted to the different States, the allotments being based largely on the prospects for the 1917 corn crop. The department's program was given the greatest publicity and an organization in each State was effected as rapidly as possible. The short time between the passage of the appropriation act and the beginning of the breeding season made some of these preparations difficult, but the colleges met the situation and lent men from their staffs to aid in the campaign. Conferences, farmers' institute meetings, and other means of publicity were used. The response to the department's appeal was given a great impetus by the announcement of the Food Administration of its plans to make purchases from the 1918 pig crop on the basis of thirteen times the average value of the corn fed for each 100 pounds of pork.

The weather during March was favorable over the entire country, and a much larger percentage of little pigs was saved than usual. The Bureau of Crop Estimates reported $9\frac{1}{2}$ per cent more brood sows on April 1, 1918, than on the same date of the preceding year. The soft corn crop caused farmers to feed out their hogs at very much heavier weights than usual during the last winter. Considering all these facts, there is every reason to believe that, although a few States did not reach their allotments, the 15 per cent increase for the entire country will be met.

FIG CLUBS.

During the year 25 specialists working in 18 States supervised 35,980 members in the boys' and girls' pig clubs, an increase of 66 per cent over the year before. The present enrollment is more than 80,000 in 28 States. Records for more than 12,000 pigs show an average daily gain of 1.14 pounds and very satisfactory profits. Seventy-one per cent of the reporting members raised pure-bred pigs. Financial aid by bankers plays an important part in the success of the pig-club work. In Mississippi more than \$50,000 has been lent to pig-club members. The increase in production of pork due to club workers is evidenced by the fact that in several States the club members are shipping their hogs to market in carload lots. The pig clubs have been the forerunners of swine-breeders' organizations, and in many States there are counties standardized to one breed of hogs as a result of the introduction of that breed for pig-club work. The specialists have advocated economical production by the use of forage and pasture crops and the feeding of garbage and table scraps.

THE POULTRY CAMPAIGN.

The poultry campaign was organized with greater deliberation than the pork campaign, because it was not necessary to do much active work before the first of January. Expert poultrymen obtained

through civil-service certification have been stationed largely in the extension divisions of the agricultural colleges. The program for poultry production called for as much increase as possible, with the idea of having poultry products release meat which could be shipped overseas. The main points of the program were as follows:

1. Keep better poultry. Standard-bred poultry improves the quality and increases production.
2. Select healthy, vigorous breeders, to produce strong chicks.
3. Hatch early, to produce fall and winter layers.
4. Have 100 hens on every farm, and get 100 eggs from every hen.
5. Preserve eggs when cheap, for home use.
6. Produce infertile eggs except for hatching.
7. Cull the flocks to eliminate unprofitable producers.
8. Keep a small back-yard flock to supply the family table.
9. Grow as much of your poultry feed as possible.
10. Eat more poultry and eggs, to conserve the meat supply.

The campaign in the field was directed by 4 district men stationed at Chicago, Kansas City, Oklahoma City, and Los Angeles, and by 36 State men in 27 States. In addition a considerable number of temporary men were appointed last spring for the period when most effective work could be done. One of the best means of bringing about increased production and greater interest in poultry raising has been the appointment of local leaders in various communities to act as volunteer assistants in disseminating the information given by the department. A large number of special leaflets and posters were prepared and several million copies have been widely circulated, in addition to the distribution of Farmers' Bulletins. Wide publicity was obtained through the cooperation of the poultry and agricultural press.

Back-yard poultry keeping in cities, towns, and villages has been advocated with a view to feeding the fowls on table scraps and kitchen waste and providing eggs for the family table. Numerous requests for information on this subject have been received. Back-yard poultry keepers are advised to purchase well-matured pullets in the fall rather than to attempt to raise chicks, and are warned against attempting to keep more hens than their table waste will provide the greater part of the feed for.

As to the results of the campaign, reports from practically every section of the country, especially the Middle West, the Far West, and the South, indicate that normal production of poultry and eggs will be maintained and in many instances increased. A survey by department agents in 28 States as to poultry conditions in 1918 compared with 1917 shows the following results: Estimates from 18 States indicate increased production, 4 show at least normal production, and only 6 a decrease, the latter due principally to the high price and scarcity of poultry feeds. Eight of the 18 States showing an increase indicate an average increased production of 48 per cent. Of the 6 showing a decrease, an average decline of 45 per cent is shown.

The preservation of eggs in water-glass solution, by people both in the cities and in the country, has been strongly urged. Eggs so preserved during the spring when relatively cheap will be available in the fall and winter when eggs are high in price. Judging from reports of field men and calls for information, a very large number of eggs were preserved during the spring and summer.

POULTRY CLUBS.

Poultry-club specialists in 8 States supervised 13,664 members in boys' and girls' poultry clubs. Approximately \$18,000 worth of poultry and eggs for market and breeding purposes were sold or consumed at home by the members, and the total value of their receipts, stock on hand, and prizes won amounted to \$41,312.42. In addition to the exhibits of fowls and eggs made at county fairs and other poultry shows, these poultry club members are now demonstrating in many instances their ability to judge poultry and to carry on the various phases of poultry work, such as setting hens, operating incubators, preserving eggs, caponizing cockerels, killing and dressing fowls for market, etc. In addition to the increased production brought about through the direct efforts of these boys and girls, they have been the means of interesting their parents and have served as entering wedges for the introduction of better methods of poultry keeping on the farms and of improved stock in general.

ANIMAL HUSBANDRY EXTENSION WORK.

In view of the stress of war requirements practically the entire Animal Husbandry Division has been and is doing extension work. The principles of the plan for cooperative extension work set forth in last year's report have been applied in the appointment of cooperative specialists to handle details of policy relating to animal husbandry extension work in cooperation with the States. The extension work is reported under other headings.

BEEF-CATTLE INVESTIGATIONS.

BEEF PRODUCTION.

The beef-cattle experimental work in Mississippi, North Carolina, and West Virginia, in cooperation with the State agricultural colleges, was continued.

At Canton, Miss., a comparison was made between rations of (1) corn silage, cottonseed meal, and oat straw, and (2) corn silage, cottonseed meal, and cowpea hay; also between rations of (1) corn silage and cottonseed meal and (2) corn silage, cottonseed meal, and oat straw, using 3 lots of 22 steers each. In the first comparison oat straw was more economical than the cowpea hay. In the second comparison no advantage was shown in adding oat straw to the ration.

At Collins, Miss., a comparison was made between a ration of whole velvet beans and corn silage and a ration of ground velvet beans and corn silage, using 2 lots of 11 steers each. It was found more economical to feed the beans whole.

At Springdale, N. C., five lots of steers were wintered and then pastured the following summer to determine the most economical method of wintering. It was found that wintering on pasture was more economical, and the steers wintered in that way made better gains on pasture the following summer.

At Lewisburg, W. Va., three lots of calves and four lots of yearlings were carried through the winter experimentally to determine the best methods of wintering. It was found most practicable to winter calves on silage and clover hay when the difficulty of getting cottonseed meal

was considered. However, the silage and cottonseed meal ration was the cheaper of the two. It was also found more economical to winter yearlings on silage, wheat straw, and cottonseed meal than on either mixed hay and wheat straw, or silage and soy-bean hay, or silage, rye hay, and cottonseed meal.

At the Animal Husbandry Farm at Beltsville, Md., an experiment was made to compare velvet beans in three different forms with cottonseed meal as supplements to corn silage and a dry roughage, and to determine the most economical form in which to feed the velvet beans in fattening steers for market. Four lots of 10 steers each were used. It was found that corn silage and velvet beans form a satisfactory ration for fattening steers for the market, and that velvet beans compare favorably with cottonseed meal, producing profitable gains when the beans are used as the sole concentrate of the ration, and that it is more profitable to soak the whole beans than to grind them; also that beans would be consumed more readily if soaked before feeding than if fed dry.

CATTLE BREEDING.

At the Canton, Collins, and Lewisburg stations the breeding herds were maintained and the work carried on the same as during the preceding year.

At the Kansas experiment station the cooperative Shorthorn breeding work was carried on as previously planned, and showed interesting results by having a number of the cows produce milk enough to qualify in the Advanced Registry of the American Shorthorn Breeders' Association.

At Collins, Miss., records were kept of the pure-bred Hereford herd to determine the cost of producing pure-bred cattle in that State.

BEEF-CATTLE EXTENSION.

Field agents in beef-cattle extension conducted work in 348 counties of Alabama, Arkansas, Florida, Georgia, Mississippi, North Carolina, South Carolina, Tennessee, and Texas. They brought into these States 914 pure-bred bulls, 2,848 pure-bred cows and heifers, 53,515 grade cows and heifers, and 8,769 grade steers, in addition to the cattle brought in from the drought-stricken area of the Southwest. They redistributed within these States, by private transactions, 61 pure-bred bulls, 41 pure-bred cows, 1,062 grade cows, and 785 steers; conducted 21 sales of pure-bred cattle and one sale of grade cattle, at which 334 pure-bred bulls, 584 pure-bred cows, and 263 grade cattle were sold; conducted 63 beef-cattle feeding demonstrations with 9,228 cattle, 17 castrating demonstrations with 103 cattle, 5 dehorning demonstrations with 49 cattle, and 360 permanent and 16 temporary pasture demonstrations with native and improved grasses; organized 37 bull clubs with 316 members, 56 calf clubs with 1,255 members, and 30 live-stock associations with 821 members; planned and constructed 522 silos, 125 barns, 47 sheds, 5 scales, and 26 feed lots; addressed 363 meetings with an attendance of 36,919 people; prepared 17 articles for publication; cooperated with 128 civic, industrial, and commercial organizations; put on 23 special campaigns; attended 12 State and county fairs; judged live stock at 67 fairs, and conducted 11 stock-judging contests with 126 contestants.

STEER-PASTURING DEMONSTRATIONS.

In Florida, Georgia, Alabama, and Mississippi 7 feeding demonstrations, with 578 head of cattle, were conducted to stimulate interest in feeding cattle on farm-grown roughages. It was found profitable to graze velvet beans and cornstalk fields. Farmers showed great interest in the demonstrations.

SWINE INVESTIGATIONS.

At the Beltsville farm feeding experiments were carried on with grade Berkshire pigs and pure-bred pigs of the different lard breeds. Experiments were conducted to show the feeding value of ground velvet beans and the effect of this feed on the quality of the pork. Experiments were carried out also with forage crops supplemented with grain rations to determine the value of this practice. Feeding trials were conducted with self-feeders to determine their value in pork production.

All animals fed are slaughtered at the Beltsville farm abattoirs. Records of the weights of the offal and various parts are kept. The meat is cured by various methods and the relative value of each method determined.

SHEEP AND GOAT INVESTIGATIONS.

Prior to July, 1917, all sheep husbandry projects were mainly of an investigational character. The efforts of the last year have been devoted chiefly to extension and educational work, planned and conducted as a part of the Federal program for increased agricultural production to meet war requirements. Extension specialists in sheep husbandry were appointed to carry on work in 17 States, under cooperative arrangements with the extension divisions of the agricultural colleges. At the outset these specialists were occupied largely in giving directions and suggestions regarding the procuring and management of breeding stock to persons taking up sheep raising for the first time. A material conservation of needed breeding stock has been effected by acquainting farmers with the location of ewes and ewe lambs that otherwise might have been sent to slaughter. Later in the season the extension work consisted chiefly of local field demonstrations of docking lambs, shearing sheep, and preparing wool for shipment. Such occasions were utilized also for urging the largest possible production of lambs and wool and for explaining the most profitable systems and methods of management.

Demonstration flocks are being established in as many counties as possible. These are privately owned, but handled on lines suggested by the specialists in conjunction with the county agents. Full records of costs and income are kept for each flock.

The United States Sheep Experiment Station at Dubois, Idaho, has become a reality. A residence and one sheep shed were constructed, and the flock has been at the new headquarters since March, 1918. Further equipment in the way of fences, watering facilities, and stock must be added to permit the carrying on of experiments planned to determine the most economical methods of utilizing the range and of wintering stock.

At the ranch headquarters an abundant supply of water for stock was procured by drilling to a depth of 740 feet. Such development of supplies of stock water has a most important bearing upon the problem of the utilization of grazing lands.

Studies to procure data upon practices in developing the farm sheep industry were continued so far as could be done after losing the services of men in immediate charge of experimental work who entered military service.

HORSE AND MULE INVESTIGATION.

BREEDING AMERICAN CARRIAGE HORSES.

At the close of the fiscal year there were in the stud at Fort Collins, Colo., 7 mature stallions, 2 3-year-old stallions, 2 2-year-old stallions, 9 yearling stallions, 7 suckling colts, 23 brood mares, 3 3-year-old mares, 7 2-year-old fillies, 7 yearling fillies, and 10 suckling fillies. Four of the mature stallions were leased for public service and stood at Montrose and Longmont, Colo., and Riverton and Shell, Wyo. Twenty-two of the brood mares were bred in 1917; 17 produced foals and 1 other is safe in foal. Fourteen of the animals were eliminated from the stud as unsuitable for breeding purposes.

During the past winter the brood mares were left out in the foothills pasture all winter, and a little hay was given them when the ground was covered with snow. The mares came through the winter in good condition and foaled without any losses among the mares or foals.

BREEDING MORGAN HORSES.

At the close of the fiscal year there were at the Morgan Horse Farm, Middlebury, Vt., 8 mature stallions, 6 young stallions, and 30 mares, 18 of which are mature. The 18 mares bred in 1917 have produced 13 foals, and 3 mares are to foal. Five of the mature stallions were sent to other points in Vermont and New Hampshire for the 1918 breeding season for the production of horses suitable for military purposes. In October, 1917, the bureau exchanged the stallion Red Oak for the 3-year-old Morgan stallion Sealskin.

Under authority of the appropriation act for the Department of Agriculture for the fiscal year 1918 a tract of land consisting of 517 acres adjoining the Morgan Horse Farm was purchased. The farm now contains 950 acres and affords ample pasture land and much additional land for the production of hay and grain.

BREEDING HORSES FOR MILITARY PURPOSES.

In the breeding of horses for military purposes the 2,019 mares bred in 1916 produced 930 living foals in 1917. During the calendar year 1917 there were 1,594 mares bred to the 35 stallions used in this work, and 428 living foals were reported up to June 30, 1918. During the first half of 1918 there were 1,022 mares bred to the 32 stallions.

COTTONSEED MEAL FOR FARM WORK STOCK.

A test in feeding cottonseed meal to horses and mules was begun in October, 1917, at the bureau's farm at Beltsville, Md. Seven draft mares and 2 driving horses were fed cottonseed meal in small

quantities, the quantity being gradually increased until 2 of the draft mares received $2\frac{1}{2}$ pounds each per day. In November, 1917, 4 mules were put on a cottonseed-meal ration. This test with both the horses and mules was still in progress at the close of the fiscal year. The results are not yet conclusive. The maximum quantity of cottonseed meal which may be fed varies somewhat with the individual animal. The indications are that 1 pound per day per 1,000 pounds live weight can be fed with safety and with better results than greater quantities, but a continuation of the experiment is desirable before drawing positive conclusions regarding the value of this feed for work stock.

POULTRY INVESTIGATIONS.

The poultry investigations at the Beltsville farm have been continued without much enlargement, since the poultry force has devoted so much of its time to new emergency extension work. Some new tests have been made in trying out products especially adaptable to war-time feeding conditions.

Considerable additional data on egg production and the transmission of this quality to both male and female lines have been obtained in the poultry-breeding experiments, which now include 1,095 trap-nested hens and pullets. Seventy matings were made this year and 3,000 chickens were hatched.

The Barred Plymouth Rock grade pen has shown remarkable improvement and compares favorably in appearance and uniformity with many pens of pure-bred Plymouth Rocks on general farms. Improvement in the White Plymouth Rock pen is not so marked, but these birds are becoming more uniform.

A considerable number of matings have been made in fixing the desired characteristics for a new breed, and a number of uniform chickens closely approaching the desired type have been bred.

Changes have been made in several of the feeding pens so that the feeding experiments comprise 25 pens containing 600 hens and pullets. Many of the experiments which have been carried over a period of several years are being continued, but all the new pens have been put on rations conforming to war-time conditions. Continued good results are being obtained with the wheatless ration, which is now in its third year of trial, while good hatches have been obtained from hens fed this ration. In addition to cottonseed meal other high-vegetable protein feeds are being used with fair success in combination with meat scrap, the best results being from cottonseed meal, peanut meal, soy-bean meal, and velvet-bean meal, in the order named. The quality of the eggs produced from these different feeds has been good in all pens. These high-vegetable protein products make up 10 per cent of the mash and are fed with 10 per cent of meat scrap. High-vegetable protein feeds without the meat scrap have not given so good results. The supply of these vegetable protein products for feeding purposes is increasing, while it is becoming more difficult to get high animal protein feed such as meat scrap. Good results are being obtained also in feeding cooked vegetables, especially waste potatoes, and one pen has been fed on garbage to find out how much value this material has in reducing the cost of feed.

A new two-story building, having a floor space 30 by 50 feet and a large cement basement, has been erected for investigations in the incubation of eggs.

PIGEON AND SQUAB INVESTIGATIONS.

The experimental flock of pigeons has been increased and additional data are accumulating. About 200 homing pigeons have been purchased for investigating the use of flying pigeons for signal work, and an extensive loft has been arranged for this work.

OSTRICH INVESTIGATIONS.

A tract of 80 acres at Glendale, Ariz., has been leased by the department for the ostrich investigations in cooperation with the Arizona Ostrich Breeders' Association, and the ostrich work was transferred to these new quarters in January. Permanent pens have been constructed and the land put into good condition and temporary buildings erected for the attendants. Six pens of birds have been mated this year.

TURKEY AND GUINEA INVESTIGATIONS.

Additional data have been gathered on the raising of turkeys and guinea fowl in the Southwest. Turkey raising is being conducted with marked success in that section.

POULTRY CLUBS.

Boys' and girls' poultry-club work has been developed in three new States this year, making a total of 11 States (Massachusetts, Rhode Island, Virginia, Kentucky, Tennessee, North Carolina, South Carolina, Georgia, Oklahoma, Kansas, and Washington), with 1,010 clubs organized in 300 counties and a membership of 15,000 boys and girls. A substantial increase in membership and results is shown. During the past year the members hatched 98,273 chicks and raised 80,310 matured fowls; more than \$17,908 worth of poultry and eggs were sold for marketing and breeding purposes or consumed at home, and the total value of the receipts, stock on hand, and prizes won amounted to \$41,312.42. Owing to congested transportation conditions and the fact that many of the smaller fairs were discontinued because of the war, poultry exhibits in many instances have been curtailed. Nevertheless, 624 members exhibited 6,208 birds and 329 dozens of eggs at 104 exhibitions, and received special and cash prizes amounting to \$3,090,75. Many club members have developed ability to judge poultry and to carry on various phases of poultry work by means of demonstrations, such as setting hens, operating incubators, preserving eggs, caponizing, killing and dressing fowls for market, etc. The poultry-club agents and members assisted materially in the emergency poultry-extension campaign for increased production.

COMMUNITY POULTRY BREEDING.

The organization of community poultry-breeding associations to standardize one breed or variety in a section has been a valuable outgrowth of poultry-club efforts. Many communities, a large

number of counties, and, in a few cases, sections of a State, including several counties, have adopted one particular breed of poultry in a standardization scheme. The work has been largely carried on through the parents and older people in States where boys' and girls' poultry club agents are assigned. One Barred Plymouth Rock association in Virginia has developed a cooperative selling association requiring a manager to handle the business. Reports from 4 States show 48 breeding associations with almost 2,500 members. In Kentucky 22 counties are organized for distributing hatching eggs of one breed of poultry in each county to the members.

ANIMAL GENETICS.

Experiments on the effects of inbreeding in guinea-pigs, begun in 1906, have now been carried to the eighteenth generation, wholly by matings of brother with sister. The mere fact that the closest possible inbreeding can be carried on through so many generations without any very obvious degeneration is noteworthy, especially as the mere following of a rigid system of mating has prevented any effective selection. There has, however, been a slow but progressive decline in all characters connected with vigor. The principal characters which have been studied are fecundity (size and frequency of litters), birth weight and later growth, and vitality as measured by the percentage of the young born alive and the percentage of these raised to weaning.

Another definite result is the pronounced differentiation of the various inbred lines which arose from the same original stock. This is most obvious in the case of color. The original matings produced as a rule a great variety of colors. Now each family has a characteristic color and pattern to which it breeds true and by which it can be identified.

Different inbred families have been crossed together very extensively. The young have shown a very distinct improvement in vitality and size and have produced larger litters than the parental stocks raised simultaneously. It appears that each family supplies much of what the other lacks, and more vigorous offspring results.

From these and other results it appears that the primary effect of inbreeding is simply the fixation of hereditary factors. The results of the crosses between different inbred families indicate that factors favorable to vigor are in general dominant over unfavorable ones. If one does not tie oneself to too rigid a system of breeding and uses from the first the greatest care in the selection of breeding stock, there appears to be no reason why a high degree of vigor can not be combined with the homogeneity and prepotency only to be secured by inbreeding.

ANIMAL HUSBANDRY EXPERIMENT FARM.

The work at the experiment farm of the bureau used by the Animal Husbandry Division, at Beltsville, Md., has been continued as heretofore. During the year a tile-ditching machine was purchased. The building erected to replace the sheep barn which was destroyed by fire three years ago has been completed and equipped. The incubator cellar and laboratory also has been completed.

CERTIFICATION OF ANIMALS IMPORTED FOR BREEDING PURPOSES.

Under the provision of paragraph 397 of the Tariff Act of October 3, 1913, the bureau issued during the fiscal year certificates of pure breeding for 512 horses, 289 dogs, and 2 cats imported for breeding purposes.

DAIRY DIVISION.

The increased and economical production and the wise use of dairy products have been objects of special activities of the Dairy Division under B. H. Rawl, chief.

DAIRY EXTENSION.

Extension work in dairying, carried on in cooperation with State agricultural colleges, serves to carry dairying into new sections, to introduce new practices developed as the result of research, and in general to unify dairy methods throughout the country. Dairy farming in general has presented unusual problems, but there has been a cordial response on the part of the dairymen to the various lines of work.

SOUTHERN DAIRYING.

Despite high prices for cotton, high cost of feed, difficulties in securing labor, and an extremely hard winter, the dairy work in the South has held its own. The efforts of the extension forces have contributed to the steady growth of dairying in Mississippi, Alabama, and in the cheese districts of the southern mountains.

Among the principal results accomplished are the organization of 6 bull associations and 11 cheese factories, the institution of cream grading in creameries in Mississippi, the organization of 2 cow-testing associations in Alabama in which 1,122 cows were put on test in typical cotton sections, and the aid given in purchasing 200 pure-bred bulls, 533 pure-bred cows and heifers, and 559 grade cows.

WESTERN DAIRYING.

Work in the interest of dairy development in the Far West has been continued in the face of such hindrances as high feed costs, the labor situation, droughts in certain sections, and unusually high prices for beef. The last two factors have led to the slaughter of dairy cows, most of which, however, were low producers. The purchase of pure-bred cows and bulls has been encouraged, with the result that dairying as a whole has shown an increase in quality rather than in quantity. Advances in the price of alfalfa have done much to impress dairymen with the importance of silage, and silos are becoming more and more a necessity. During the year 189 silos were built in the West with the assistance of Dairy Division field men.

COW-TESTING ASSOCIATIONS.

The work of the cow-testing associations, the organization and operation of which are encouraged and supervised by the Dairy Division, has suffered because of the lack of men to serve as testers. These organizations are composed each of about 26 farmers who hire

a tester to keep the production and feed records of their cows by means of data gathered at a one-day's monthly visit to each farm. Up to the present year there has been a steady increase in the number of these associations in operation each year. The total number of associations active June 30, 1918, was 357, composed of 9,847 dairy-men owning 172,518 cows, compared with 472 associations, 12,088 dairymen and 216,831 cows a year before. Last year it was practically impossible in many cases to obtain testers. This prevented the organization of many associations and caused numerous others to become inactive. Wisconsin, with a total of 112 active associations compared with the 81 of last year, furnished a notable exception to the general showing of the several States. Various expedients have been used in the different States to meet the need for cow testers. Graduates of county agricultural schools, under 21 years of age, high-school boys, women, and men above draft age have all been used.

The cooperative buying of feed has become a general practice in many associations. Fifteen organizations in Iowa saved \$4,392 on the purchase of cottonseed meal alone, and another association in the same State saved \$3,382 on the purchase of feeds and seeds. In Indiana several associations purchased cooperatively 50 carloads of grain, and in Wisconsin a like quantity was bought, while in Minnesota \$5,000 was saved in feed buying.

A new feature of the work in Wisconsin was the establishment of a "Cow-Testing Association Register of Production" in which cows may be entered after producing 365 pounds of butterfat in one year under cow-testing association supervision.

BULL ASSOCIATIONS.

Cooperative bull associations, formed by groups of farmers for the cooperative purchase, use, and exchange of high-class dairy bulls, are likewise promoted and supervised by the Dairy Division and have reached a stage of development where their value is more fully appreciated by dairy farmers. In the Southern States bull associations are giving good results. In North Carolina and South Carolina they have been especially successful in increasing their membership and the number of pure-bred and grade cows. One association in the latter State in less than three years has developed a section, previously without dairying, into a recognized dairy center. In the Far West, although special attention to bull associations covered a period of only three months, 3 associations were organized and many others are in prospect.

On June 30, 1918, there were 44 active associations composed of 1,900 members owning 225 bulls, 597 pure-bred cows, and 10,248 other cows, a gain of 8 associations, 726 members, 36 bulls, 61 pure-bred cows and 2,263 other cows over the preceding year.

COMMUNITY DEVELOPMENT IN DAIRYING.

The work in community dairy development at Grove City, Pa., which was organized for demonstrating what could be accomplished in the dairy development of a community by means of the help rendered by a dairy specialist and for determining the profitableness of such intensive development, has been continued with good results. Much has been accomplished through the local organizations, namely,

the Holstein-Friesian Bull Association, the Jersey Bull Association, the Guernsey Breeders' Association, the Creamery Patrons' Association, the Cow-Testing Association, and the Boys' and Girls' Pure-bred Dairy Cattle Club. Permanent improvement is shown by the building of 25 silos, and the remodeling of 57 barns.

The Holstein-Friesian and Jersey bull associations have each added another block and increased their membership. Most of the members of these associations, as well as of the Guernsey Breeders' Association, have signed agreements for tuberculin testing under the bureau's accredited-herd plan. During the year 73 farmers, 40 of whom had never owned pure-bred cows before, purchased 20 pure-bred bulls and 133 pure-bred cows. In linking up the farm to the town, 20 farmers have joined the commercial club and are serving on important committees.

DAIRY DEMONSTRATION FARM, DENISON, TEX.

The farm near Denison, Tex., owned by a group of local business men and supervised by a specialist of the Dairy Division, was started several years ago as a demonstration of the value of dairying and of what could be accomplished by dairying in building up worn-out cotton land. During the year there was a general improvement in conditions at the farm; buildings and equipment were repaired, new fences built, and some new equipment installed. The average price received for milk was 34 cents a gallon. Crops raised were only fair, dry weather having affected some of them unfavorably.

CONTROL OF INFECTIOUS DISEASES.

A veterinarian was assigned to the study of contagious abortion and tuberculosis in cooperative cow-testing and bull associations. Considerable success has been attained already in inducing members of these associations to take up the accredited-herd plan of tuberculosis eradication.

THE COTTAGE-CHEESE CAMPAIGN.

As a part of the movement for the conservation and wise utilization of food, a vigorous campaign has been waged to bring cottage cheese to the attention of the people and to encourage the wider production and consumption of that valuable food. Cottage cheese, which is made from skim milk and buttermilk, has presented opportunities for the use of these dairy by-products, hitherto largely fed to live stock or actually wasted. In cooperation with the Office of Home Economics of the States Relations Service and the Bureau of Markets of the department, the campaign was begun in a fourfold manner with (1) women demonstration agents working in cities, demonstrating and encouraging the use of cottage cheese in various dishes, (2) women agents demonstrating the making and use of cottage cheese in the rural districts, (3) dairy experts working with creameries and milk plants and giving instruction in improved methods of making high-grade cottage cheese, and (4) market experts visiting the cities where the women demonstrators were to work, to insure a plentiful supply of cottage cheese of good quality at reasonable prices.

After special training in the making and various uses of cottage cheese, five women demonstration agents carried on campaigns in 40 of the leading cities in 15 States, a stay of from one to two weeks being made in each place. Cooperation was established with the local women demonstration agents, the Food Administration representatives, women's clubs, and other local agencies. Special material was prepared for use in the newspapers before, during, and after the campaign. In some cities the work was carried on as a part of a campaign to increase the consumption of all dairy products and was advertised by posters, newspapers, stores, milk dealers, and business men. Efforts were made to reach all classes of women and to place before them by actual demonstrations the many and varied uses of cottage cheese. Talks and demonstrations were given in schools, Red Cross rooms, community kitchens, women's clubs, tea rooms, department stores, cafeterias, and before gatherings of mill workers and others.

It is difficult to ascertain definite results from the city demonstrations, but reports from 56 manufacturing concerns and dealers in the cities where campaigns were carried on showed that their weekly sales had increased nearly 30,000 pounds in spite of the fact that it was the usual slack season. One creamery in Michigan reported an increase in sales of more than 8,000 pounds in two weeks, and another producer in Minnesota stated that in three days his sales had jumped seven times in volume. In one western city the daily sales before the campaign were about 50 pounds, while afterwards the sales rose to 900 pounds a day.

The farm campaign was carried on by women demonstration agents who worked as a part of the State extension forces and in cooperation with the local Food Administration representatives, county agents of the department, and other agencies. These women visited various towns and villages throughout the States and gave demonstrations before groups of women. Every effort was made to reach all classes of women and to demonstrate the simple method of making cottage cheese and the numerous ways of using it. Forty States were visited, 2,092 demonstrations and meetings were held with an aggregate attendance of 102,218, while 41,499 people reported having made cottage cheese as a result of the work. At the time of reporting these people were making the cheese at the rate of more than 100,000 pounds a week, with weekly sales of 33,500 pounds, and their total output since the beginning of the campaign had amounted to more than 580,000 pounds. In the Middle West the girls' canning clubs took up the making of cottage cheese.

The dairy manufacturing specialists of the Dairy Division worked with the creameries and milk plants which supply cottage cheese to the cities and assisted them in improving the quality and increasing the quantity. One hundred and twenty-one factories were induced to take up the manufacture of cottage cheese, and the total quantity made during the period in which help was given (July to October, inclusive, 1917, and April to June, inclusive, 1918) amounted to 3,098,700 pounds. In addition, assistance was given in improving the quality and yield in 154 other plants where cottage cheese was manufactured.

DAIRY MANUFACTURING INVESTIGATIONS.

Special efforts have been directed toward increasing the efficiency of operation of creameries and improving the quality of their product. Economical fuel consumption has been specially urged, not only for the financial benefit of the creameries but as a measure of conserving coal. The utilization of exhaust steam for heating wash water and boiler-feed water and for pasteurizing has been encouraged, and 42 exhaust-steam water heaters have been installed through the efforts of the field men. In each case a saving of about 20 per cent of the fuel bill was effected. Other creameries were advised as to the better arrangement of their steam plants and the more economical use of power. Increased efficiency was obtained in many creameries through a more careful system of testing, simpler methods of accounting, and the reduction of the loss of fat in the buttermilk. Improved methods in two Vermont creameries increased the incomes in one year by \$2,800 and \$4,000, respectively.

As in previous years, every effort has been made to improve the quality of creamery butter through a more careful system of manufacture and a more careful inspection of the cream. In every case in which the division's recommendations were adopted an improved quality and a correspondingly better return for butter were the result. An Iowa creamery, through the grading of cream and the payment of a premium for good, sweet-flavored cream, received 3 cents a pound more for its butter, making a gain of \$3,000 for the year. Similar work at two other creameries in the same State entitled them to the privilege of using on their butter the Iowa State brand, a mark indicating high-grade butter.

The Dairy Division has continued to give assistance in the fundamentals of creamery operation in the South, where there has been an increase in the production of creamery butter as compared with the preceding year, notwithstanding the diversion of much milk and cream to the Army camps and cantonments. A cream-grading campaign in Mississippi was remarkably successful. Eighteen of the 21 creameries in that State adopted grading, which has proved a factor in better quality and better prices.

In the Western States, where the demand for milk by condensaries has tended to reduce the output of butter, the division's efforts have been directed especially toward standardizing the product by means of scoring contests as well as personal visits to creameries. There is a growing tendency in that, as in other sections of the country, for creameries to request assistance and to follow advice given.

THE GROVE CITY CREAMERY.

The creamery at Grove City, Pa., operated by the Dairy Division, has been of great value in providing facilities for testing, on a commercial scale, methods developed through laboratory research for manufacturing all classes of dairy products. The development of that creamery has made it necessary to provide a larger building and more equipment, and a \$60,000 addition is now in course of construction. This additional space will provide facilities for the manufacture of various kinds of cheese and at the same time allow more room for the creamery. Probably the greatest development has been in the quantity of milk received. Because of the high price paid for skim

milk, many patrons, instead of bringing cream as formerly, have brought whole milk, the skim milk being made into cottage cheese and condensed skim milk. The patrons of the creamery have received good prices for their milk and cream. In the last fiscal year as compared with the preceding year the average number of patrons increased from 414 to 534; the quantity of whole milk purchased increased from 2,081,314 to 4,003,804 pounds; cream purchased, from 1,042,244 to 1,085,891 pounds; butterfat churned, from 425,084 to 506,498 pounds; cottage cheese manufactured, from 139,585 to 352,825 pounds; condensed skim milk, from 506,832 to 647,756 pounds; the average price paid for butterfat rose from 47.2 cents to 55.6 cents a pound and the average price paid for skim milk from 57 cents to 81.6 cents per hundred pounds.

CHEESE-FACTORY EXTENSION.

As a result of the cheese-factory extension work in the mountainous sections of the South 11 new factories were organized during the fiscal year, making a total of 41 in operation in the South. Most cheese factories built in previous years have shown satisfactory growth and development and are providing an outlet for dairy products in regions remote from transportation facilities. The quality of southern cheese is generally satisfactory and there is a good demand for it.

In the Western States the cheese work has been confined largely to increasing the efficiency of operation and improving the quality of the product rather than organizing new factories. In spite of the difficulties caused by unsettled conditions and the changing of cheese-makers, considerable progress has been made toward producing a high quality of cheese.

INSPECTION OF BUTTER FOR THE NAVY.

The quantity of butter contracted for by the Navy Department has been increased from 2,700,000 pounds in 1917 to more than 8,000,000 pounds for 1918. This butter is being made under careful inspection in 90 factories scattered through Iowa, Minnesota, California, Michigan, Wisconsin, and Pennsylvania. As in previous years, the manufacture of the butter is supervised by the inspectors of the Dairy Division. The butter is made from pasteurized, unripened sweet cream and is of high quality, uniform grade, and good keeping qualities. The demand by the Navy for first-class butter has done much to stimulate creameries throughout the country to improve the quality of their product.

INSPECTION OF RENOVATED-BUTTER FACTORIES.

The number of renovated-butter factories has decreased from 19 at the beginning of the fiscal year to 16 at its end. Only 19,405,672 pounds of renovated butter was made during the year, of which 17,340 pounds was exported. During 1917 the product amounted to 27,542,015 pounds. The quality of packing stock used during the fiscal year 1918 was inferior to that of previous years. Suggestions for improvement have been willingly accepted by the factories and a general improvement has been made.

MILK INVESTIGATIONS AND DEMONSTRATIONS.

SANITARY MILK SUPPLIES FOR ARMY AND NAVY.

Assistance has been rendered to the United States Public Health Service in sanitary surveys of zones about Army and Navy establishments. The necessity for a safe milk supply at such places is obvious. Most of the Army cantonments and camps are situated in the South, in regions where the supply of milk is limited. Efforts were made to bring about improvement through suggestions rather than by the application of drastic regulations which might easily have reduced the available supply still more. The work consisted of either complete or partial surveys of the dairies, bacterial counts of the milk, and inspection of the pasteurizing plants; in short, the milk was watched from the time it left the cow until it was consumed. So far the milk supplies of 16 Army and Navy establishments have been investigated and great improvement has resulted.

SANITARY SURVEYS OF CITY MILK SUPPLIES.

In addition to the Army cantonment zones, 12 cities and towns were worked with, and 773 dairy farms were scored for sanitary conditions, 1,045 other dairies were visited, 7,011 bacterial counts were made, and 111 milk plants were scored. In the work of improving conditions 57 other towns in 16 States were visited and in many cases assistance was rendered. Sanitary surveys are now made more comprehensive and complete, and for that reason fewer cities have been visited than in former years.

A monthly letter, containing information of timely interest both to producers and consumers, was sent regularly to 1,500 local health officers.

MILK CONTESTS.

The milk contest is more and more proving its value as a means of improving a city milk supply and keeping it at a high level of quality. Eight contests held during the year under the immediate supervision of the Dairy Division resulted in four cities definitely adopting milk grading with regular contests.

FARM STERILIZER AND MILK-COOLING CAMPAIGNS.

The campaign to encourage the sterilization of milk utensils on the farm has been continued with excellent results. Simple steam sterilizers were sent to 180 health departments and to 25 State agricultural colleges for demonstration. One hundred and seventy-two health departments demonstrated the sterilizer to 5,799 people, and it is believed that the colleges have been no less successful.

A campaign urging the more thorough and prompt cooling of milk and cream to below 50° F. on the farm has been carried on and is being continued. Incidental to this effort the construction of ice houses and the putting up of ice in the winter has been encouraged. Posters, leaflets, and press articles, in addition to the regular publications, have been distributed in very large numbers through the cooperation of health officers, creameries, cheese factories, milk plants, and State extension agencies.

Experiments to determine what can be accomplished by the use of the best sanitary methods of producing and handling milk have been applied practically among the dairymen supplying milk and cream to the Grove City creamery. As a result, the patrons are beginning to realize the importance of sanitary requirements, the sterilization of milk utensils, the use of small-top milk pails, clean udders, and prompt and proper cooling of milk and cream.

MILK-PLANT MANAGEMENT.

As a result of studies in milk-plant management, seven accounting forms have been prepared which it is believed will materially assist owners of milk plants by providing simpler and more accurate methods of keeping accounts. Milk plants in 23 cities have been visited either to collect data or to render assistance. Considerable assistance was given also to farmers' cooperative milk-distributing companies, both in the planning of plants and in the selection of equipment, and advice was furnished to numerous owners of milk plants as to more efficient methods of conducting their business. Estimates of the cost of operating plants and of the handling and delivery of milk, and plans for milk plants and lists of equipment have been sent out in response to inquiries.

COST OF MILK PRODUCTION.

Investigations of the cost of producing milk have been completed after two years' work at a locality in North Carolina and at one in northern Indiana, while others are in progress in Vermont, Nebraska, Louisiana, and Washington. So far, only the Indiana results have been tabulated, but they are believed to be typical of the general region supplying whole milk to Chicago. The records bring out strikingly the relationship of various debit and credit factors to the total cost of production. Next to feed, an item which demands the closest attention is manure. The method of handling this valuable fertilizer is often an important factor in the net profit. By attention to the four following factors it was found possible to reduce appreciably the cost of production: (1) Raising the average production per cow, (2) reducing the quantity of concentrates fed to low producers, (3) substituting legume roughage for part of the concentrates, and (4) more careful handling of the manure.

DAIRY RESEARCH LABORATORIES

BACTERIOLOGY.

Much fundamental research work has been carried on which is applicable to other industries as well as dairying. This is particularly true of some of the bacteriological investigations which have given an insight into the physiology and relationships of bacteria and which have developed new methods of study. For the most part this work is of so technical a nature that it is of interest only to laboratory workers, but the results eventually lead to improved methods of great value in practical work. For example, a study of the sources from which bacteria can obtain the carbon needed for their growth has led to an improved medium for the direct enumeration of fecal bacteria in milk and water. The methods of

identifying the fecal bacteria have been much simplified by a study of the effect of the concentration of acid on the growth of bacteria. An entirely new line of investigations of this nature has yielded preliminary results of such promise that it has been considered advisable temporarily to suspend work on the dysentery group, started in cooperation with the Council of National Defense, until more definite results can be obtained.

A study of the different varieties of the colon-aerogenes group of bacteria is being made in cooperation with a committee of the United States Public Health Association by means of methods developed in the Dairy Division laboratories.

The possibility of using the presence of fecal bacteria of the sporogenes type as an indication of the pollution by manure is being studied. As the result a method of separating this type from contaminating bacteria has been developed, a description of which, on account of its probable value in working with wound infections, has been transmitted to the Medical Corps of the Army.

In the studies of the *Bacterium abortus* type, which have been completed, it was shown that there are two or more distinct but closely related types of the organism, one of which is widely distributed but probably not pathogenic. *Bacterium abortus* was shown to be either identical with, or at least closely related to, the organism causing Malta fever.

MILK SECRETION.

In the studies of the changes in the nature and amount of phosphorus and calcium in the blood, it was possible to demonstrate that the phosphatid of the blood plasma is reduced after passing through the active mammary gland. The conclusion has been drawn, therefore, that plasma phosphatid is the immediate precursor or forerunner of both butterfat and milk phosphorus. Progress has been made in determining just how the variations in the various phosphorus fractions of the blood are produced and as to what influence they have upon milk secretion, growth, and other physiological processes. Evidence has been obtained supporting the view that dairy cattle under ordinary conditions often suffer from inability to absorb sufficient calcium and phosphorus to meet the requirement of moderately heavy milk production. In preliminary experiments the feeding of rations containing moderate quantities of feed nutrients in such manner as to favor the absorption of calcium and phosphorus has yielded such encouraging results that it is desirable to repeat the work on a larger scale and under more controlled conditions.

SILAGE INVESTIGATION.

Studies of wood and concrete silos and of the nitrogen losses in silage have been completed. As an incidental feature of the latter investigation it was found that a coating of hot paraffin served as a perfect protection for cement against silage juices, and that tar and asphalt paints were ineffective. An investigation is in progress concerning the fermentation of silage that takes place when crops are cut at various stages of growth. A study is also being made of the availability of crops such as sunflowers and sugar cane for silage.

CONDENSED MILK.

Investigations of condensed milk have been carried on along three different lines, namely, the cause and control of "buttons" or reddish lumps occurring on the surface of condensed milk, the quantity of sugar necessary to preserve milk, and the factors affecting viscosity. In the first study it was demonstrated that "buttons" are caused by the action of molds and that by careful attention to the source of infection the trouble can be prevented. Progress has been made on a study to determine the concentration of sugar essential to the preservation of milk. The principal factors influencing the viscosity of milk, both when freshly condensed and after standing, have been determined. An investigation is under way also to determine the influence that certain factory conditions have upon these factors.

MANUFACTURE AND RIPENING OF CHEESE.

The methods of manufacture of cheeses of the Roquefort, Camembert, and Swiss types have been so developed that it is the intention to manufacture these products on a commercial scale at Grove City, Pa., as soon as the addition to the creamery is completed. Improved methods for making Neufchâtel, cream, and cottage cheese have been developed so as to make a more uniform and higher-quality product, and it has been found possible to make the last-named cheese from a mixture of high-grade buttermilk and skim milk. Parmesan, a low-fat cheese, is being studied at present with a view to determining whether it is possible to make it satisfactorily in this country.

An organism has been isolated from Swiss cheese which has not previously been described and which apparently produces the "eyes" or gas cavities characteristic of that cheese. There is good reason to believe that this new culture can take the place of the starter made from old cheese and that its use will result in a more uniform grade of cheese. Cultures have been isolated from Cheddar cheese which produce the characteristic Cheddar flavor in cheese made from pasteurized milk, and similar cultures have been used to control the flavor of cream cheese.

CREAMERY BY-PRODUCTS.

Much time and effort has been spent in developing factory methods for the manufacture of casein from skim milk and buttermilk. Since casein is one of the important constituents of the waterproof glue needed in the use of "plywoods" in the airplane and other industries, studies are being made in cooperation with the forest products laboratory to determine whether it is possible to manufacture a high-grade casein from medium and low-grade buttermilk. These two form the only abundant supply available, since high-grade buttermilk and skim milk are now used largely for human food. If it is found possible to purify low-grade buttermilk or the resulting casein made from it, an abundant and cheap supply of casein will be available.

Studies of the utilization of whey are in progress to determine whether primost of good quality can be made from whey of high acidity.

DISPOSAL OF CREAMERY WASTES.

In cooperation with the Public Health Service the proper size of settling tank and sand filter bed has been determined for creameries. Much of the previous difficulty has been due to holding sewage too long in the settling tank and using too small a filter bed.

DAIRY CATTLE BREEDING

The need has long been felt for a thorough and comprehensive study of the breeding problems connected with dairy cattle. Little definite information is available regarding the influence of inbreeding, line breeding, and crossbreeding. Plans have been prepared and part of the necessary animals have been purchased to undertake comprehensive experiments on these questions and at the same time to collect data from breeders. These experiments, which will cover a long period of years, will be carried out in cooperation with a number of State agricultural colleges and other institutions in order that the greatest possible number of data may be obtained through the use of a large number of animals.

DAIRY EXPERIMENT FARM.

The Dairy Division experiment farm at Beltsville, Md., is used as an experimental field for various lines of experimental and practical work in dairying and also as a laboratory for research work.

INFLUENCE OF WATER UPON MILK AND BUTTERFAT PRODUCTION.

The effect of water upon the production of milk and butterfat has been studied in a preliminary manner by using different systems of watering the cows. Watering once or twice a day was compared with allowing the cows to drink at will and the latter was found to have a slight advantage, especially over watering once a day.

FACTORS CAUSING VARIATION IN PERCENTAGE OF BUTTERFAT IN MILK.

Previous experiments had indicated that a ration high in mineral and water content influenced the percentage of butterfat in milk. An experiment in which a ration of high mineral and high water content was compared with one of low mineral and low water content gave negative results.

MILK SUBSTITUTES FOR CALVES.

Various combinations of grain have been tried as milk substitutes for feeding calves, but a combination has not been found as yet which is considered fully satisfactory.

FEED REQUIRED FOR RAISING HEIFERS.

The feed necessary to raise five dairy heifers for one year was found to average 125 pounds of whole milk, 2,420 pounds of skim milk, 889.9 pounds of grain, 568.3 pounds of alfalfa hay, and 4,411.9 pounds of corn silage. At birth the average weight was 79 pounds, and at one year the weight had increased to an average of 520 pounds. The grain mixture used consisted of 375 pounds of corn-and-cob meal, 200 pounds of wheat bran and 100 pounds of linseed-oil meal.

EXPERIMENTS WITH SILAGE.

Preliminary experiments in ensiling legumes, such as sweet clover, alfalfa, soy beans, and cowpeas, and the last two crops mixed with corn, have resulted in very satisfactory silage which did not have a strong putrefactive odor. None of these furnished silage which proved as palatable as that made from corn, and none seemed to have a feeding value equal to that of corn silage.

FEEDING VALUE OF VELVET-BEAN MEAL.

In a feeding experiment of 100 days with two lots of three cows each, meals from hulled velvet beans and cottonseed meal were compared. Alfalfa hay and corn silage were fed ad libitum and the meals compared were supplemented by a mixture of corn meal and wheat bran, equal parts. An effort was made to feed each cow 4 pounds of the meal a day and in addition enough of the corn-meal-and-bran mixture to insure her receiving 8 pounds of grain for each pound of butterfat produced. It was found impossible, however, to get all the cows to eat 4 pounds of velvet-bean meal. While the trials are only preliminary, the indications are that 1 pound of cottonseed meal is approximately equivalent to 1.5 pounds of velvet-bean meal for milk and butterfat production.

MEAT INSPECTION DIVISION.

The Federal meat inspection has continued under the Meat Inspection Division with R. P. Steddom as chief. The statistics for the fiscal year show a decline in the total number of animals slaughtered and an increase in the quantity of meats processed and in the quantity of meats and products certified for export.

INSPECTION OF DOMESTIC MEATS.

Inspection was conducted at 884 establishments in 263 cities and towns, as compared with 883 establishments in 253 cities and towns during the fiscal year 1917.

Inspection was begun at 83 establishments and withdrawn from 74 establishments during the year, as compared with 84 and 82, respectively, during 1917. Inspection was withdrawn from 67 establishments on account of discontinuance of slaughtering or of interstate business, from 2 for failure to comply with department requirements, from 3 by request, and from 2 which were exempted from inspection.

ANTE-MORTEM INSPECTION.

The ante-mortem inspections, given in the following table, show an increase in the number of cattle and calves inspected and a decrease for each of the other species, the decrease in the total inspections being 7.9 per cent from those of the fiscal year 1917.

Ante-mortem inspection of animals.

Class of animals.	Passed.	Suspected. ¹	Condemned. ²	Total inspected.
Cattle.....	10,901,935	104,112	51	11,006,098
Calves.....	3,307,669	5,725	18	3,313,412
Sheep.....	8,770,463	4,786	4	8,775,253
Goats.....	149,536	80		149,616
Swine.....	35,382,591	95,609	3,864	35,482,064
Total.....	58,512,194	210,312	3,937	58,726,443

¹ This term is used to designate animals found or suspected of being unfit for food on ante-mortem inspection, most of which are afterwards slaughtered under special supervision, the final disposal being determined on post-mortem inspection.

² For additional condemnations see succeeding tables.

POST-MORTEM INSPECTION.

The post-mortem inspections show a decrease of 7.9 per cent from the preceding year and an increase of 4.2 per cent over the average for the last 11 years, during which the new meat-inspection law has been operative. While there was a decrease in the number of sheep, goats, and swine slaughtered, the increase in cattle amounted to nearly 1,750,000 and in calves to more than 600,000.

Post-mortem inspection of animals.

Class of animals.	Passed.	Condemned.	Total inspected.
Cattle.....	10,870,131	68,156	10,938,287
Calves.....	3,314,968	8,109	3,323,077
Sheep.....	8,756,934	12,564	8,769,498
Goats.....	149,084	419	149,503
Swine.....	35,336,168	113,079	35,449,247
Total.....	58,427,285	202,327	58,629,612

CONDEMNATIONS.

The next two tables show the diseases and conditions for which condemnations were made.

Diseases and conditions for which condemnations were made on ante-mortem inspection.

Cause of condemnation.	Cattle.	Calves.	Sheep.	Goats.	Swine.
Arthritis.....					13
Blackleg.....	3				
Emaaciation.....	4	10	3		23
Exhaustion.....	1	1			
Hemorrhagic septicemia.....	1				
Hog cholera.....					3,754
Injuries.....	4				28
Milk fever.....	6				
Moribund.....	2				1
Pneumonia.....	16	5	2		22
Rabies.....	2				
Septicemia.....	5	2			14
Temperature.....	7				
Tumors and abscesses.....	1				9
Total.....	52	18	5		3,864

Diseases and conditions for which condemnations were made on post-mortem inspection.

Cause of condemnation.	Cattle.		Calves.		Sheep.		Goats.		Swine.	
	Car-casses.	Parts.	Car-casses.	Parts.	Car-casses.	Parts.	Car-casses.	Parts.	Car-casses.	Parts.
Actinomycosis.....	391	114,571	21	1,578	.....	1	.....	.....	3	14
Adenitis.....	.....	1	.....	.....	1	13	.....	.....	.....	.....
Adhesions.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....
Arthritis.....	.....	21	.....	4	.....	14	.....	.....	.....	13
Asphyxia.....	7	.....	6	.....	23	.....	.....	.....	861	.....
Atrophy.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	7
Blackleg.....	35	.....	13	.....	.....	.....	.....	.....	.....	.....
Bone diseases.....	7	1	4	.....	2	.....	1	.....	43	3
Caseous lymphadenitis.....	.....	.....	.....	.....	1,566	.....	31	.....	.....	.....
Cellulitis.....	.....	.....	.....	.....	.....	.....	.....	.....	2	174
Congestion.....	18	.....	1	.....	9	.....	.....	.....	24	.....
Contamination.....	4	1,433	2	34	1	19	.....	.....	217	1,666
Cysticercus.....	306	794	36	8	110	8	.....	.....	435	7
Dropsical diseases.....	25	.....	3	.....	18	.....	.....	.....	58	.....
Emaciation.....	12,492	.....	2,041	.....	4,979	.....	297	.....	544	.....
Exhaustion.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....
Frozen.....	.....	.....	.....	.....	.....	.....	.....	.....	7	1
Gangrene.....	75	.....	16	.....	5	.....	.....	.....	25	.....
Hemorrhagic septicemia.....	106	.....	.....	.....	.....	.....	.....	.....	1,037	.....
Hernia.....	7	.....	1	.....	3	.....	1	.....	22	.....
Hog cholera.....	.....	.....	.....	.....	.....	.....	.....	.....	20,967	.....
Hydronephrosis.....	.....	.....	.....	.....	.....	.....	.....	.....	12	.....
Icterus.....	40	.....	57	.....	762	.....	8	.....	2,109	.....
Immaturity.....	.....	.....	1,749	.....	.....	.....	4	.....	4	.....
Inflammation.....	.....	9	.....	.....	.....	.....	.....	.....	.....	.....
Injuries, bruises, etc.....	2,950	775	402	96	278	130	10	.....	698	5,973
Leukemia.....	437	2	14	.....	11	.....	.....	.....	128	.....
Melanosis.....	31	12	16	3	9	.....	.....	.....	57	.....
Moribund.....	14	.....	5	.....	18	.....	.....	.....	41	.....
Necrobacillosis.....	19	.....	.....	10	.....	4	.....	.....	3	1
Necrosis.....	2	688	.....	2	1	.....	.....	.....	.....	2
Parasitic diseases.....	5	8	1	.....	8	1	.....	.....	122	.....
Phlebitis.....	.....	.....	131	.....	.....	.....	.....	.....	.....	.....
Pneumonia, peritonitis, metritis, enteritis, pleurisy, etc.....	6,575	.....	1,678	.....	4,000	.....	45	.....	15,363	.....
Pregnancy and recent parturition.....	47	.....	.....	.....	23	.....	6	.....	24	.....
Septicemia, pyemia, uremia.....	2,529	.....	879	.....	638	.....	6	.....	8,773	.....
Serous infiltration.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....
Sexual odor.....	.....	.....	.....	.....	.....	.....	8	.....	588	.....
Skin diseases.....	.....	.....	1	.....	.....	.....	.....	.....	14	.....
Texas fever.....	510	.....	503	.....	.....	.....	.....	.....	.....	.....
Tuberculosis.....	40,792	58,209	477	362	.....	.....	1	.....	59,740	332,834
Tumors and abscesses.....	732	2,415	52	210	98	37	2	.....	1,158	6,311
Total.....	68,156	178,940	8,109	2,308	12,564	227	419	1	113,079	347,006

The following table shows the total condemnations on ante-mortem and post-mortem inspection combined:

Summary of condemnations.

Class of animals.	Animals or carcasses.	Parts.
Cattle.....	68,208	178,940
Calves.....	8,127	2,308
Sheep.....	12,568	227
Goats.....	419	.....
Swine.....	116,943	347,006
Total.....	206,265	528,481

In addition to the foregoing, the carcasses of 71,327 animals found dead or in a dying condition were tanked, as follows: Cattle, 5,438; calves, 3,939; sheep, 6,033; goats, 214; swine, 55,703.

INSPECTION OF MEAT AND PRODUCTS.

The inspection and supervision of meats and products prepared and processed is shown in the following table, which is a record only of supervisory work performed and not a statement of the aggregate quantity of products prepared. The same product is sometimes duplicated by being reported in different stages of preparation under more than one heading.

Meat and meat food products prepared and processed under inspection.

Kind of product.	Pounds.	Kind of product.	Pounds.
Placed in cure:		Meat extract.....	2,637,630
Beef.....	308,830,414	Lard.....	943,850,811
Pork.....	3,132,549,417	Lard oil.....	581,759
All other.....	2,613,489	Lard stearin.....	476,662
Sausage, chopped.....	624,826,613	Compound and other substitutes.....	463,164,587
Canned product:		Pork to be eaten uncooked.....	38,533,847
Beef.....	363,106,730	Oleo stock and edible tallow.....	50,897,563
Pork.....	96,313,099	Oleo oil.....	141,080,439
All other.....	9,212,815	Oleostearin.....	71,651,711
Sterilized product:		Oleomargarin.....	265,334,705
Beef.....	3,754,457	Miscellaneous products.....	1,377,145,356
Pork.....	8,613,830		
All other.....	8,990	Total.....	7,905,184,924

The quantities of meat and meat food products condemned on reinspection on account of having become sour, tainted, putrid, unclean, rancid, or otherwise unwholesome, were as follows: Beef, 9,396,215 pounds; pork, 7,918,185 pounds; mutton, 83,061 pounds; veal, 141,688 pounds; goat meat, 4,035 pounds; total, 17,543,184 pounds.

MARKET INSPECTION.

Market inspection was begun during the fiscal year at one city, making a total of 43 cities at whose public markets this inspection is maintained in order that interstate deliveries of meats and products may be made therefrom.

MEAT AND PRODUCTS CERTIFIED FOR EXPORT.

The following products were certified for export under certificates and stamps: Beef and beef products, 723,559,990 pounds; mutton and mutton products, 2,413,916 pounds; pork and pork products, 1,784,472,896 pounds; a total of 2,510,446,802 pounds. In addition there were issued 214 certificates covering the export of 3,639,895 pounds of inedible animal products.

EXEMPTION FROM INSPECTION.

The provisions of the meat-inspection law requiring inspection usually do not apply to animals slaughtered by a farmer on a farm nor to retail butchers and dealers supplying their customers. Retail butchers and dealers, however, in order to ship meat and meat food products in interstate or foreign commerce, are required first to obtain certificates of exemption. The number of exemption certificates outstanding at the close of the fiscal year was 2,498, a decrease of 58 from the preceding year. During the year 100 certificates were canceled, 88 on account of the dealers retiring from business or ceasing to make shipments, 7 for violations of the regulations, 4 because

the business was of a wholesale nature, and 1 dealer was granted inspection.

During the year 45,530 shipments, amounting to 4,299,620 pounds, were made by retail dealers and butchers holding certificates of exemption, as compared with 67,779 shipments, amounting to 6,698,597 pounds, during the fiscal year 1917. The shipments of the year covered products as shown in the following table:

Shipments by retail dealers and butchers under certificates of exemption from inspection.

Product.	Num-ber.	Pounds.	Product.	Num-ber.	Pounds.
Beef, carcasses (1,122 quarters)...	280	110,230	Cured meats.....		294,013
Veal, carcasses.....	25,803	2,232,767	Lard.....		14,605
Sheep, carcasses.....	409	18,377	Sausage.....		64,266
Swine, carcasses.....	1,053	126,957	Miscellaneous (scrapple, tripe, headcheese, etc.).....		29,147
Beef, fresh.....		884,347			
Veal, fresh.....		164,024	Total.....	27,545	4,299,620
Mutton, fresh.....		163,955			
Pork, fresh.....		196,932			

During the fiscal year 73,746 interstate shipments, amounting to 11,535,525 pounds, were made of meats and meat food products from animals slaughtered by farmers on the farm, as compared with 87,486 shipments, amounting to 14,146,842 pounds, during the fiscal year 1917. The following table shows the products covered by these shipments:

Shipments of farm-slaughtered products under exemption from inspection.

Product.	Num-ber.	Pounds.	Product.	Num-ber.	Pounds.
Beef, carcasses (4,304 quarters)...	1,076	387,154	Cured meats.....		758,364
Calves, carcasses.....	91,372	8,299,540	Lard.....		129,385
Sheep, carcasses.....	3,029	103,959	Sausage.....		109,208
Swine, carcasses.....	12,413	1,430,357	Miscellaneous (scrapple, tripe, headcheese, etc.).....		20,215
Beef, fresh.....		30,634			
Veal, fresh.....		64,340	Total.....	110,890	11,535,525
Mutton, fresh.....		1,574			
Pork, fresh.....		200,795			

INSPECTION OF IMPORTED MEATS.

The following table shows the inspection of imported meats and meat food products for the fiscal year, and represents an increase of 102.56 per cent over the inspections for the preceding year:

Imported meat and meat food products inspected.

Country of origin.	Fresh and refrigerated meats.		Cured and canned meats.	Other products.	Total weight.
	Beef.	Other classes.			
	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.
Argentina.....	184,613	1,840,379	11,248,925	8,437,438	21,711,355
Australia.....			642,887	256,832	899,719
Brazil.....	1,525,682		2,548,975	9,730	4,084,387
Canada.....	15,884,609	3,743,987	1,451,995	191,191	21,276,782
Uruguay.....			7,185,038	2,155,806	9,340,844
Other countries.....	1,235,525	69,816	158,917	248,139	1,712,397
Total.....	18,830,429	5,659,182	23,236,737	11,299,136	59,025,484

The following statement shows the condemnations of imported meats and the amounts refused entry on account of lack of foreign certificates or other failure to comply with the regulations:

Import meat products condemned or refused entry.

Product.	Con- demned.	Refused entry.
	<i>Pounds.</i>	<i>Pounds.</i>
Beef.....	891,972	147,390
Veal.....	1,200	
Mutton.....	9,733	
Pork.....	87,011	267,062
Total.....	989,916	414,452

INSPECTIONS FOR OTHER BRANCHES OF THE GOVERNMENT.

By request of the War and Navy Departments and of the Immigration Service, of the Department of Labor, reinspections of meats and meat food products to determine whether they were wholesome and conformed to the specifications were made during the fiscal year. Inspections were made at 71 camps for the War Department and at 45 places for the Navy Department. The following table shows the amounts of these and other inspections.

Inspection for other branches of the Government.

Department.	Inspected.	Rejected.
	<i>Pounds.</i>	<i>Pounds.</i>
War Department.....	231,945,641	2,805,604
Navy Department.....	81,793,418	2,283,396
Interior Department (Indian Affairs).....	171,350	2,016
Department of Labor (Immigration Service).....	114,055	91
Panama Railroad Co.....	16,459	
Total.....	314,040,923	5,091,107

MEAT-INSPECTION LABORATORIES.

In the meat-inspection laboratories maintained in Washington and six other cities of the country, samples of each meat food product prepared at official establishments are examined to determine whether they are properly labeled and contain no deleterious substance. Samples are analyzed of the various materials used in the curing and preparation of meat and products, such as water and spices, salt, etc., and of the various substances used in and around establishments, such as inks, disinfectants, and insect and rodent exterminators, and permission for use is based upon the results of such examinations. During the last year all the laboratories did a great deal of work in examining samples of meat food products prepared for the Army and the Navy to determine whether they contained any harmful substances and met the Army and Navy specifications.

The total number of samples examined by the laboratories during the year was 64,502, of which 57,282 were domestic, 779 imported products, and 6,441 were for the War and Navy Departments. These figures show an increase of 4,686 over the number for the preceding

year. One thousand three hundred and sixteen samples were found not to be in accordance with the regulations, 64 of which were from imported products and 16 from military products. Water supplies from 735 sources were examined, 119 of which were condemned for use in the preparation of meat products.

The study of the rancidity of fats has been continued, and has now progressed so far that it is possible to assert definitely that the condition known as rancidity is entirely due to oxidation.

QUARANTINE DIVISION.

The work of inspection and quarantine of imported live stock, the inspection of animals for export, and the inspection and disinfection of imported hay, hides, wool, etc., have been conducted by the Quarantine Division under the direction of R. W. Hickman, chief.

INSPECTION AND QUARANTINE OF IMPORTED ANIMALS AND PRODUCTS.

New regulations have been issued for the inspection and quarantine of horses, cattle, sheep, swine, and other animals imported into the United States (B. A. I. Order 259), and to govern the importation of hides, fleshings, hide cuttings, parings, glue stock, sheepskins, and goatskins and parts thereof, hair, wool, and other animal by-products, and hay, straw, forage, or similar material (Joint Order No. 2 of the Treasury Department and the Department of Agriculture). Some new ports of entry have been designated for the convenience of shippers, and the bureau is authorized in special cases and with the concurrence of the customs authorities to designate other stations than those specifically named in the regulations.

Shipments from Great Britain to the United States have been coming forward with a fair degree of regularity, though, as in the preceding year, importations of live stock have been below the normal average.

Early in the fiscal year the animal quarantine station for the port of Baltimore, Md., situated on the water front near that city, was turned over to the War Department for Army use; consequently permits have not been issued for the importation of ruminants and swine at Baltimore. The stations at Boston and New York, however, have been maintained, thus affording accommodations for importers entering live stock at Atlantic coast ports.

Under authority of the food production act, joint regulations were issued October 1 by the Secretary of the Treasury and the Secretary of Agriculture providing for the importation of tick-infested cattle from the Republics of Mexico and South and Central America and from the islands of the Caribbean Sea for immediate slaughter at ports of entry below the southern cattle-quarantine line. It was provided by Congress that cattle imported under the provisions of the act should be slaughtered in accordance with the meat-inspection law, and also that all such animals were to be shown to be free from exposure to the infection of any disease other than tick fever during the 60 days next before their exportation.

During the year 40 cattle were shipped into Porto Rico from the Virgin Islands. While the Virgin Islands belong to the United States the quarantine laws of the United States do not apply to them, as they are under the control and jurisdiction of the Navy Department.

Accordingly, these cattle, upon arrival at Porto Rico, were treated as imported cattle.

The following tables show the importations of the various kinds of live stock through the different ports of entry:

Imported animals inspected and quarantined.

Port of entry.	Cattle.	Sheep.	Swine.	Other animals.
New York.....	809	303	2	67
Boston.....	209	484		
San Francisco.....		437		442
Canadian border ports.....	2,462	524	171	42
Total.....	3,480	1,748	173	551

Imported animals inspected but not quarantined.

Port of entry.	Cattle.	Sheep.	Swine.	Goats.	Horses.	Other animals.
New York.....					474	
Boston.....					1	
Tampa.....				2	32	
Jacksonville.....	1,983				2	
Key West.....					202	
New Orleans.....					14	
Ponce, P. R.....	40					
Mexican border ports.....	107,061	39,227	452	25,832	5,396	7
Canadian border ports.....	184,781	116,832	13,216	16	9,499	89
Total.....	293,865	156,059	13,668	25,850	15,620	96

Inspectors of the bureau also inspected and held in quarantine for the Bureau of Biological Survey 6,177 live quail imported from Mexico for breeding purposes.

The bureau has continued to maintain an inspector in Great Britain, and during the year there were tested with tuberculin under his supervision in the United Kingdom 920 cattle for importation into the United States. There were also tested after arrival at the quarantine stations in this country 133 cattle, of which number 4 reacted to the test. This work is shown in the following table:

Results of tuberculin tests of cattle for importation into the United States.

Breed.	Tested in Great Britain.		Tested in quarantine.	
	Tested.	Failed.	Tested.	Failed.
Aberdeen-Angus.....	4			
Ayrshire.....			33	3
Guernsey.....	445	1	73	1
Friesian.....	3			
Jersey.....	212		6	
Shorthorn.....	256	21	21	
Total.....	920	22	133	4

Through the courtesy of the Governments of Argentina, Uruguay, Brazil, and Paraguay, a veterinary inspector of the bureau spent the greater part of the last two years in those countries investigating

matters pertaining to food animals and their products and cooperating with the officials of those countries with a view to the extension of their export shipments of meat and animal by-products to the United States. Such shipments since the war began have become comparatively heavy owing in part to the loss of the European markets by the South American countries.

IMPORTATIONS OF ANIMAL BY-PRODUCTS.

Systematic enforcement of the regulations (Joint Order No. 2) governing the importation of hides, skins, and other animal by-products has been instrumental in improving the sanitary control methods of handling these products, both in the countries which export them to the United States and in the establishments in this country to which they are consigned. There have been fewer instances of anthrax infection from such sources, notwithstanding the fact that anthrax has been exceedingly prevalent in several of the hide-exporting countries. As statistics of importations are kept by the Treasury Department the bureau has not compiled statistics of inspections of the products mentioned. It is known, however, that large quantities of hides and skins were imported during the fiscal year.

INSPECTION OF ANIMALS FOR EXPORT SHIPMENT.

The regulations governing the exportation of live stock have special reference to inspections for health and the humane handling and safe transport of such animals to destination. In addition to the designation of suitable and convenient places of inspection, rules for the fitting of vessels, specifications of materials to be used, dimensions of lumber and pens, and the space to be allowed each of the different kinds of animals are indicated. The rules and regulations of the country to which the animals are to be consigned likewise receive careful attention.

During the fiscal year 344 inspections of vessels carrying live stock were made before clearance. Shipments of horses and mules to Europe were light. The mallein test was applied to 10,067 horses and 342 mules for shipment to Canada; 7 of these horses reacted and were rejected. For shipment to Canada 1,816 cattle were tested with tuberculin, with 9 reactors, and inspections for Canadian shipment were made of 7,880 sheep, 151 swine, and 393 goats. For shipment to other countries 1,026 cattle were tested with tuberculin and 3 reacted; the mallein test was applied to 33 horses with no reactors; 37 swine and 12 sheep also were inspected.

The following table gives statistics of inspection of live stock for export, including 41,065 horses and 24,438 mules intended for army use in Europe:

Inspections of animals for export.

Kind of animals.	American.	Canadian.
Cattle.....	4,910	.....
Sheep.....	8,233	.....
Swine.....	365	.....
Goats.....	403	.....
Horses.....	51,340	.....
Mules.....	25,088	150
Total.....	90,339	150

FIELD INSPECTION DIVISION.

The Field Inspection Division, under A. W. Miller, chief, has carried on work for the control and eradication of certain animal diseases.

INSPECTION FOR FOOT-AND-MOUTH DISEASE

As a precaution against the reappearance of foot-and-mouth disease the assignment of experienced veterinarians to make careful inspections for this disease in all cattle, sheep, and swine received at public stockyards was continued. Numerous suspected outbreaks of this disease reported to the bureau were investigated promptly, with negative results in all instances.

ERADICATION OF SCABIES.

In the work of eradicating sheep scabies in cooperation with State officials, 19,630,126 inspections of sheep were made in the field by bureau employees, and 5,585,543 sheep were dipped.

The work of eradicating the disease in Montana and Nevada, where outbreaks occurred during the latter part of the preceding fiscal year, was practically completed. During the year the bureau, in cooperation with the State officials of Idaho and Wyoming, was engaged in combating a considerable spread of the infection in those States, where for several years previously the disease had existed to a very limited extent, and satisfactory progress was made toward its elimination from affected herds. During the year 1,367 square miles in Louisiana were placed under quarantine on account of the prevalence of sheep scabies therein, and 239,484 square miles in Texas were released from such quarantine.

In the eradication of cattle scabies in cooperation with State officials, bureau employees in the field made 1,829,532 inspections of cattle, and 642,831 cattle were dipped. A few scattered outbreaks of the disease, which occurred in several States, were quickly brought under control. The remaining area under Federal quarantine, 3,817 square miles in Texas, was released.

Horses and mules to the number of 6,755 were inspected for scabies, and the dipping of 545 of these animals was accomplished under bureau supervision.

ERADICATION OF DOURINE.

Satisfactory progress was made in the work of eradicating dourine in most of the States in which the disease prevailed. No infected animals were found during the fiscal year in Iowa and Nebraska, where the work had been completed the preceding year, and only a small number in North Dakota and Wyoming. Although a considerable number of infected animals were found in South Dakota and Montana, the good progress of previous years in the eradication of the disease in those States was continued. New areas of infection, in addition to the large areas in which it was known that the disease prevailed, were found in Arizona and New Mexico. A very large proportion of the infection in those two States was found among horses ranging on Indian reservations, and the work of eradicating the disease on the reservations was extremely difficult, because most of the Indian horses are wild ponies, ranging in rough and

inaccessible regions. On the whole, the officials of the State concerned and the horsemen in the affected areas have cooperated with the bureau in a satisfactory manner. The bureau continued the practice of paying one-half of the appraised valuation of infected horses destroyed, such share not to exceed \$100 in any case. The number of animals tested and the results of the tests are reported by the Pathological Division. The percentage of reactions was 2.23, as compared with 2.47 for the preceding year. A very large proportion of the diseased animals continue to be found among horses belonging to Indians living on reservations under a tribal form of government.

INSPECTIONS OF ANIMALS FOR INDIAN AGENCIES.

In cooperation with the Office of Indian Affairs of the Department of the Interior, 43 horses and mules and 842 cattle were inspected and passed for allotment to the several Indian agencies.

CONTROL OF INFLUENZA, ANTHRAX, AND BLACKLEG.

In connection with the war emergency campaign to stimulate the production and conservation of live stock, work was conducted looking to the control of influenza, anthrax, and blackleg and to a reduction of the losses from these diseases.

In the work against influenza of horses and mules 70 bureau employees were assigned to work in cooperation with State officials and the War Department. Activities covered practically all large markets and assembling points in the country and included supervising the cleaning and disinfection of cars, stockyards, barns, and other premises used in the handling of horses and mules, the inspection of such animals at market centers, and the supervision of the segregation and treatment of those found to be diseased. The measures taken gave good results in effecting a material reduction in the losses of horses and mules from the disease.

Cooperation was extended to the State officials of 15 States in the control and reduction of anthrax. Several bureau employees were regularly assigned to this work, and others were detailed as occasion required to assist owners and local officials in carrying out measures necessary to combat the disease and prevent its spread. These employees supervised the disinfection of infected premises and the proper disposal of carcasses of animals which died from anthrax, and whenever necessary assisted the owners of infected or exposed herds in the vaccination of all susceptible animals on the premises. Good results were obtained in the reduction of losses caused by the disease.

On the request of stockmen or other interested persons bureau employees were detailed to investigate outbreaks of blackleg in young cattle, to advise owners as to proper treatment, and, if necessary, to assist in the vaccination of animals in affected herds or localities.

TICK ERADICATION DIVISION.

Greater progress than in any previous year was made in the work of exterminating the ticks which transmit Texas or tick fever of cattle, conducted through the Tick Eradication Division under the direction of R. A. Ramsay, chief, in cooperation with the authorities of the Southern States affected.

ERADICATION OF SOUTHERN CATTLE TICKS.

Areas aggregating 67,308 square miles, as shown by the following table, having been freed of ticks, were released from quarantine during the fiscal year. The total area released since the beginning of this work in 1906 amounts to 379,312 square miles, which is more than 52 per cent of the originally infected area. The work is also far advanced in a large additional territory.

Areas released from quarantine as a result of eradicating cattle ticks.

State.	Square miles.	State.	Square miles.
Alabama.....	9,859	North Carolina.....	1,079
Arkansas.....	13,305	Oklahoma.....	3,240
Florida.....	1,100	Texas.....	11,835
Georgia.....	5,559	Virginia.....	90
Louisiana.....	5,883		
Mississippi.....	15,358	Total.....	67,308

During the year 34,927,959 inspections or dippings were made of cattle for the eradication of ticks, as against 24,390 721 in the preceding year. There were in operation 26,470 cattle-dipping vats where cattle were dipped under Federal or State supervision to rid them of ticks.

A great deal of advance work pertaining to the construction of dipping vats and preparing counties and localities for taking up regulatory tick-eradication activities in the near future was conducted in an effort to get proper organization in such localities, and there are indications that during the next fiscal year systematic dipping will be taken up in greatly increased area. Very effectual cooperation has come from transportation companies, commercial clubs, bankers, and other business men who are far-sighted enough to realize that the eradication of the cattle tick and the subsequent development of the live-stock industry means an increase of business for all concerned.

The work accomplished in tick eradication in the last year makes available 86 counties and 37 parts of counties into which better bred cattle from tick-free States may be taken without danger of loss from tick fever. A consequent increase in meat and dairy products may be expected. In addition the hides of all cattle will be improved in grade to a degree which will render them 20 to 50 per cent more valuable.

SHIPMENTS FROM QUARANTINED AREAS.

The number of cattle of the quarantined area shipped to market centers for immediate slaughter was 3,015,875, which is a considerable increase over the preceding year and was brought about by local conditions such as drought which required the immediate marketing of many cattle. Then, too, there has been manifested by many cattle owners in tick-eradication localities a disposition to ship for slaughter as many unprofitable cattle as possible in preference to dipping them. This was done with the view of procuring, after ticks are eradicated, better-bred animals likely to be more profitable for breeding purposes. "Dipped ticky cattle" to the

number of 13,179 were shipped to points where inspection and dipping facilities are maintained for further treatment for movement as non-infectious.

At points other than public stockyards 383,513 cattle were inspected or dipped and certified for interstate movement as noninfected, as provided for in the regulations. To cover the shipments of these cattle 2,108 certificates were issued.

TUBERCULOSIS ERADICATION DIVISION.

The Tuberculosis Eradication Division, with J. A. Kiernan as chief, has taken up cooperative work for the control and eradication of tuberculosis of live stock in 40 States. Live-stock sanitary officials of the States in most instances have expressed a willingness to cooperate with the bureau in this work. Cattle owners throughout the country are becoming more interested in the eradication of tuberculosis from live stock, especially in the movement to establish tuberculosis-free herds of pure-bred cattle.

The compulsory tuberculin testing of cattle has been continued in the District of Columbia, and of 1,206 cattle tested 12 reacted, a trifle less than 1 per cent.

COOPERATIVE TUBERCULOSIS INVESTIGATIONS.

A summary of cooperative tuberculin testing in the various States is given in the following table. This work was done by bureau veterinary inspectors and by veterinarians regularly employed by the respective States. Bureau inspectors in charge of tuberculosis-eradication work are stationed at 26 points throughout the country:

Results of cooperative tuberculin testing of cattle.

State.	Tested.	React- ing.	React- ors slaugh- tered.	Per cent reacted.	State.	Tested.	React- ing.	React- ors slaugh- tered.	Per cent reacted.
Alabama.....	4,083	44	8	1.2	New Hampshire..	249	17	6	6.83
Arkansas.....	130	.....	.....	.....	New Jersey.....	570	29	29	5.09
Connecticut.....	592	42	36	7.11	New Mexico.....	567	6	6	1.06
Delaware.....	71	.....	.....	.....	New York.....	196	30	27	15.31
District of Co- lumbia.....	1,206	12	10	1.0	North Carolina...	2,108	63	22	2.99
Florida.....	456	37	36	8.0	North Dakota....	14,869	502	260	3.38
Georgia.....	4,563	170	152	3.70	Ohio.....	3,360	153	71	4.55
Idaho.....	1,454	90	63	6.19	Oregon.....	1,805	62	30	3.43
Illinois.....	2,508	590	42	23.52	Pennsylvania.....	1,045	60	24	5.74
Indiana.....	2,325	107	91	4.65	Rhode Island.....	163	13	8	8.0
Iowa.....	197	29	14	14.72	South Carolina...	3,594	89	52	2.48
Kentucky.....	838	8	.....	.96	South Dakota....	1,246	86	14	6.90
Louisiana.....	1,093	20	7	1.83	Tennessee.....	2,684	111	70	4.14
Maine.....	4,706	184	139	3.91	Texas.....	936	20	16	2.14
Maryland.....	3,171	170	143	5.36	Utah.....	4,019	65	60	1.62
Massachusetts...	2,004	235	154	11.73	Vermont.....	7,472	989	863	13.24
Michigan.....	3,769	203	164	5.39	Virginia.....	18,627	548	491	5.90
Minnesota.....	12,138	493	512	4.06	Washington.....	1,424	84	33	2.94
Mississippi.....	1,944	21	11	1.80	West Virginia....	257	7	6	2.72
Missouri.....	19	1	1	5.26	Wisconsin.....	3,087	70	3	2.26
Montana.....	18,597	1,084	939	5.80	Total.....	134,042	6,544	4,625	4.88

TUBERCULOSIS-FREE ACCREDITED HERDS OF CATTLE.

A good beginning has been made in the establishment of a list of herds of pure-bred cattle officially accredited as being free from tuberculosis. A statement of methods and rules was adopted by the United States Live Stock Sanitary Association and by representatives of pure-bred cattle breeders' associations in December, 1917, and was approved by the Chief of the Bureau of Animal Industry. The plan, in brief, is to test the cattle with tuberculin at the request of the owner, to eliminate any reacting animals either by slaughter or by following prescribed sanitary measures, to repeat the test at prescribed intervals, and to list as tuberculosis-free accredited herds all herds entitled to that distinction. Official certificates are issued to the owners of such herds. A list of accredited herds and of herds that had successfully passed one test with a view to certification, comprising herds tested up to the end of the fiscal year, has been printed and a summary is given in the following table. An "accredited" herd is one that has successfully passed two annual or three semi-annual tests. The herds "tested once without reactors" must pass subsequent tests before being accredited and certified. The work shown in the following table forms a part of that composing the preceding table.

Summary of herds of cattle officially accredited as free from tuberculosis and of herds that have passed one test with a view to later certification.

Breed.	Accredited.				Tested once without reactors.			
	Number of herds.	Pure-bred cattle.	Grade cattle.	Total cattle.	Number of herds.	Pure-bred cattle.	Grade cattle.	Total cattle.
Aberdeen-Angus.....	5	128	9	137	28	442	118	560
Ayrshire.....	4	82	2	84	17	332	77	409
Brown Swiss.....	2	27	0	27	1	1	13	14
Devon.....					1	35	7	42
Dutch Belted.....					1	21	0	21
Galloway.....					2	23	11	34
Guernsey.....	35	1,007	409	1,416	122	1,308	1,976	3,284
Hereford.....	5	262	0	262	58	1,771	458	2,229
Holstein-Friesian.....	48	1,360	341	1,701	267	4,120	2,562	6,622
Jersey.....	48	1,282	303	1,585	205	3,621	1,978	5,599
Milking Shorthorn.....					1	9	3	12
Polled Durham.....	3	114	32	146	7	179	12	191
Polled Hereford.....					1	10	20	30
Red Polled.....	15	347	45	392	10	151	41	192
Shorthorn.....	39	1,134	61	1,195	170	2,265	708	2,973
Total.....	204	5,743	1,202	6,945	891	14,288	7,924	22,212

LIVE-STOCK SANITARY WORK IN INTERSTATE COMMERCE.

In the course of the inspection and quarantine service to prevent the spread of animal diseases through interstate commerce there were inspected at market centers 20,987,998 cattle, of which 52,092 were dipped under bureau supervision in order that they might continue in interstate transit. Sheep to the number of 17,019,386 were inspected at stockyard centers for scabies and other contagious diseases, and 651,339 were dipped under bureau supervision in order that they might be disposed of for purposes other than immediate slaughter.

Swine to the number of 254,731 were inspected and under the bureau's supervision were given the immunization treatment against hog cholera for interstate shipment from public stockyards.

Bureau stations reported 23,441 cars as arriving at points where inspection is maintained, carrying animals affected with a contagious, infectious, or communicable disease. During the year 42,069 cars were cleaned and disinfected under bureau supervision on account of bureau regulations or on request of Canadian government officials, State officials, and transportation companies.

There were inspected by bureau veterinarians, in compliance with the laws of the States to which the animals were destined, and upon request of transportation companies or cattle owners, 84,400 cattle moving interstate for purposes other than immediate slaughter, of which 26,667 were tested with tuberculin. Of the number tested 745 reacted, indicating that they were affected with tuberculosis, and 54 showed temperatures which required them to be held as suspects for further examination.

There were also inspected by bureau veterinarians, in compliance with the laws of the States to which the animals were destined, and upon request of transportation companies or shippers, 25,798 horses and mules, 10,228 of which were tested with mallein, 1 showing typical reactions to the test, and 2 were held for further examination.

VIOLATIONS OF LIVE-STOCK TRANSPORTATION AND QUARANTINE LAWS.

The bureau has continued to report to the Solicitor of the department, for presentation to the Attorney General for prosecution, cases of apparent violations of live-stock transportation and quarantine laws. Many of these cases have required special investigation on the part of bureau employees, such as interviewing witnesses and examining railroad and other records for the completion of evidence. Six bureau employees were regularly assigned to this work, though the greater part of the work of collecting evidence and preparing and submitting reports is done by bureau employees at stockyard centers, in connection with their other duties. The enforcement of the so-called 28-hour law has resulted in better facilities being provided for the feeding, watering, and handling of live stock in transit.

TRANSFER OF WORK.

The supervision of the interstate transportation of live stock and the work relating to the enforcement of the 28-hour law have been transferred to the Field Inspection Division, effective July 1, 1918.

PATHOLOGICAL DIVISION.

The Pathological Division, which was supervised by John R. Mohler in addition to his duties as assistant chief of the bureau up to December 10, 1917, and of which John S. Buckley has since been acting chief, has been engaged mainly, as heretofore, in the scientific investigation of diseases of animals and in assisting in the control of viruses, serums, and other remedies used in the treatment of live stock. Special cooperation with the War Department in dealing with diseases of horses and mules was a feature of the year's work.

GLANDERS INVESTIGATIONS.

In connection with cooperative work with State authorities for the control of glanders of horses and mules the complement-fixation test was applied to 1,411 samples of serums, 251, or 17.8 per cent, of which gave positive reactions to the test.

Cooperative work was done with the War Department in the control and eradication of glanders among Army horses and mules. The complement-fixation test was applied to 800 samples of serum from horses and mules at various remount depots and cantonments throughout the country. These samples were largely from animals giving an indefinite reaction to the ophthalmic mallein test, or were sent in for a confirmation of positive findings with the allergic tests, and also in cases in which every possible precaution to exclude glanders infection was to be used. Stock solutions of glanders antigen for the complement-fixation test were furnished to various Army laboratories, together with details of the technic of the test as conducted by the bureau.

Limited tests, on glanderous mules, of a mallein prepared from strains of *Bacillus mallei* isolated from lesions in mules did not show this mallein to be any more specific than mallein made from strains of the organism from horses.

DOURINE.

The complement-fixation test has continued to be extensively employed for the diagnosis of dourine of horses, 45,651 samples of serum having been tested, 1,018, or 2.23 per cent, of which gave positive reactions to the test.

A second multiple pipette has been devised for handling serum samples, whereby large numbers of samples can be tested easily in the daily routine with less help than in previous years. An improved method in the preparation of the dourine antigen by the use of distilled water to eliminate the red blood cells in collecting the trypanosomes has been found very satisfactory.

Cooperative work was done with the War Department in the testing for dourine of a number of samples of serum from mares which were to be used for breeding purposes to insure their being free from this disease.

ABORTION DISEASE.

Efforts to acquire more definite information regarding infectious abortion of cattle have been continued, the procuring of further evidence as to how the disease is disseminated, and the possibilities of immunization as a means of control having received particular attention. Numerous methods of obtaining information have been employed, namely, (1) the utilization of cattle in experiments where the environment could be controlled, (2) the observation of infected herds where the disease has existed for a variable length of time, and (3) the bacteriological and histological study of the tissues of suspected animals obtained from abattoirs.

By making repeated serological tests of numerous herds, both where the infection was of recent origin and where it was known to have existed for several years, a marked difference has been noted in the rapidity with which the disease spreads, even though the herds

have been maintained under very similar conditions. Additional evidence has been obtained that susceptible pregnant heifers may readily acquire the disease through the ingestion of comparatively small amounts of infected material, and that nonpregnant cows as a result of ingesting the infection may develop positive serum reactions and eliminate abortion bacteria in their milk.

While experimental work thus far conducted has failed to incriminate the bull as an actual disseminator of the disease at time of service, bacteriological examinations of the generative organs of 33 male animals, the blood serum of which showed some agglutinating properties for abortion bacteria, yielded positive results in three instances. There are grounds for suspecting that bulls of this character may be capable of contaminating their environment with abortion infection and in this manner at least be menacing factors as disseminators of the disease.

Immunization experiments with vaccines on animals where the exposure has been controlled, and also under herd conditions, have been in progress for some time, but the work has not advanced sufficiently to justify drawing any definite conclusions.

Serological tests applied at regular and frequent intervals to the blood serum of pregnant heifers to which had been administered by the mouth a sufficient quantity of abortion-infected material to cause them to abort later has demonstrated that a wide variation exists in the period of time that intervenes before agglutinins or complement-fixing bodies are elaborated. The negative period following the administration of the infection in seven cases, all of which subsequently aborted, varied from three weeks to four and one-half months. The fact that animals give negative serum reactions at the time of removal from infected herds need not, therefore, necessarily imply that they are not harboring the abortion organism, and that they may not develop positive serum reactions and abort at a considerably later period.

EXAMINATIONS FOR TUBERCULOSIS.

Specimen tissues from 86 cattle that had reacted to the tuberculin test, but in which no visible tuberculous growths had been found on post-mortem examination, were referred to the pathological laboratory for decision as to the presence of tuberculous lesions. By means of microscopic examination or animal inoculations, or both, the presence of tubercle bacilli was demonstrated in 63 of the samples, while 23 gave negative results.

A specimen of unusual interest, found during the regular course of meat inspection, consisting of the lungs from a cow bearing lesions similar to those of tuberculosis, yielded an organism which is evidently one of the pseudotubercle bacilli and which is being studied.

OIDIOMYCOSIS IN CATTLE.

Experimental work on coccidioidal granuloma (oidiomycosis) has been completed, and from the data obtained the following conclusions have been drawn: The affection has been observed in cattle as a natural infection of the bronchial and mediastinal lymph glands. It is transmissible experimentally to guinea pigs, rabbits, dogs, cattle, sheep, and swine. Cattle affected with the disease show no

response to subcutaneous allergic tests. Neither specific complement-fixing bodies nor agglutinins can be detected in the sera of affected animals. A paper reporting this work has been prepared for publication in the Journal of Agricultural Research.

DISEASE OF EYES OF CATTLE.

A disease of the eyes of cattle appeared in the summer of 1917 on a farm in Maryland. The history of the outbreak showed that after the first few animals had been affected for a short time the disease spread rapidly, or within two days, to other lots of cattle, some of which were at a distance from the ones first attacked.

The disease was characterized by a profuse flow of tears, followed by cloudiness of the cornea and the development of ulcers upon the surface of the cornea. In the progress of the disease the cornea became opaque, and in the worst cases the whole eye seemed involved, resulting in total blindness in one or both eyes.

Many attempts to isolate a pathogenic organism from the eyes of the affected cattle were made, but without success. It was found to be impossible to transmit the disease to healthy cattle or to laboratory animals by means of inoculating them with any of the bacteria recovered from the diseased eyes.

In treating the affected eyes the best results were obtained from a 1 per cent solution of silver nitrate applied to the eye gently with a soft cotton swab every second day until there was noticeable improvement and every fourth or fifth day thereafter until the eye became clear or free from the inflammation.

INFLAMMATION OF THE JOINTS IN SWINE.

Enlarged and inflamed joints (arthritis) of swine have been found often in the course of meat-inspection observations, and when the diseased joints are those of the hams or shoulders the loss in meat food products becomes of some importance. Investigations of the condition have therefore been made.

A large percentage of the joints examined contained a small Gram-positive red-shaped organism which resembles *Bacillus pyogenes* in morphology but differs from it in a few cultural characteristics. Results of experiments indicate that this unidentified organism is a causative factor of the arthritis. A pig inoculated intravenously with a pure culture of the organism on two occasions developed arthritis with distention of the synovial capsule, a condition typical of the early stages of the natural disease, and a pure culture of the organism was recovered from the lesion. Similar inoculation of grown hogs yielded negative results, older animals seeming more resistant to the infection than pigs one or two months of age. Rabbits were also infected by inoculation.

IMPROVED METHOD IN COMPLEMENT-FIXATION TEST.

The Pathological Division has devised an improved method for recovering trypanosomes from the blood of rats for antigen purposes in connection with the complement-fixation test which is used in the diagnosis of several diseases. A description of this method has been prepared for publication in the Journal of Agricultural Research.

FORAGE POISONING.

No further evidence has been obtained that *Bacillus botulinus* is a factor in forage poisoning of animals, but reports from other sources indicate that this organism has been responsible for the deaths of horses and sheep. It is a fact of long-standing knowledge that it is possible to produce an antiserum against disease caused by *B. botulinus*, and several animals have been treated with the idea of producing a serum for experimental purposes in spontaneous outbreaks of forage poisoning, but it has not been found feasible as yet to follow up this line of research in order to demonstrate definitely its worth.

RABIES

The number of cases examined for rabies was somewhat less than during the preceding year. One hundred and fourteen suspected cases were received and submitted to laboratory examination. Of this number 45 were positive, 65 negative, and in 4 cases no diagnosis could be made, as the material had undergone advanced decomposition. The cases included 93 dogs, 6 cats, 10 cattle, 4 hogs, and 1 sheep. Thirty-four of the cases were from the District of Columbia, 18 from Maryland, 51 from Virginia, 4 from West Virginia, and 7 from other States. In every instance where a person had been bitten, animal inoculation was made when the microscopic findings were negative.

BLACKLEG VACCINE.

The demand for vaccine for immunizing cattle against blackleg has continued, and enlarged facilities have enabled the division to meet all demands promptly. During the year 4,204,975 doses were distributed to stock owners free of charge.

With the object of producing an immunizing agent against blackleg which would possess a higher degree of potency than the attenuated virus vaccine that is in common use at the present time (Kitt's method and modifications), experiments were undertaken to produce a germ-free toxic culture filtrate and to determine its relative potency. After many attempts a process was devised for preparing such a product possessing highly satisfactory immunizing properties and for concentrating the vaccine in paste form so as to make it relatively stable. Necessary dilutions are made with water at the time of inoculation into the animal to be immunized.

ANTIANTHRAX SERUM.

Serum from horses that are immune to anthrax has been prepared for the treatment of that disease, both in man and in animals, and many requests for it have been filled, notably in emergency cases in which anthrax has been diagnosed in human patients, and where serious outbreaks were causing heavy losses of live stock.

POULTRY INVESTIGATIONS.

A large number of experiments were carried out with various drugs and antiseptics used in the treatment of disease for the purpose of establishing in each case the toxic dose for fowls. Through the knowledge thus gained it is possible to fix the most effective medicinal dosage. Little information on this subject appears in the literature on poultry diseases.

Farmers' Bulletin 530, "Important Poultry Diseases," was revised and new subjects added. Considerable poultry material was received for diagnosis, and information and advice were given to correspondents.

AUTOPSIES ON WILD ANIMALS.

During the year 108 specimens of wild animals from the National Zoological Park were received for post-mortem examination. The one reptile examined was affected with a severe parasitism of both the digestive canal and the lungs. Of 70 birds, 31 were affected with enteritis, 6 with gastroenteritis, 1 with impaction of the crop, 1 with peritonitis, 1 with pericarditis, 1 with gout, 3 with anemia (cachexia), 1 with hemorrhage, 1 with tumor, 5 with tuberculosis, 4 with aspergillosis, 4 with septicemia, and 11 were undertermined. Of 37 mammals, 1 was affected with enteritis, 14 with gastroenteritis, 1 with pneumoenteritis, 1 with peritonitis, 7 with pneumonia, 1 with anemia (cachexia), 1 with hemorrhage, 5 with tuberculosis, 1 with pyemia, 3 with septicemia, 1 killed as unfit for exhibition, and 1 was undetermined.

An outbreak of an acute inflammatory affection of the upper air passages and lungs in a group of bears kept in adjoining cages was shown by bacteriologic study of the internal organs of two animals that succumbed to the disease to be due to infection with a virulent strain of an organism of the colon type.

BRANCH LABORATORIES.

Branch pathological laboratories have been maintained for several years at Chicago, Ill., and Omaha, Nebr. During the past year they made many laboratory investigations for the purpose of assisting the veterinary inspectors in the meat-inspection service to make proper disposal of the carcasses coming under their observation that showed pathological changes.

During the year a new branch was established at Denver, Colo., mainly for the study and prevention of infectious diseases among domestic animals of the western portion of the United States.

PLANT POISONING OF STOCK.

The work in the investigation of poisonous plants has been conducted on the same general lines as in preceding years. While the extended experimental work is carried on in the field, this is supplemented by the pharmacological, pathological, and chemical work done in the laboratories in Washington. The cooperation of the Forest Service and of the Bureau of Plant Industry has been continued and adds material assistance to the completeness of the work. Further improvements have been made at the well-equipped summer field station in the Fish Lake National Forest, near Salina, Utah, provided by the Forest Service. The addition of a chemist to the investigative force has made it possible to do much more complete experimental work.

The study of poisoning by oak leaves which has been carried on for three years is nearly completed and the results confirm the popular opinion of the losses from this cause. They show under what condition these losses occur and indicate how they may be prevented. A preliminary paper on this subject was published (Leaflet A. I. 32) and a more extended paper prepared for publication.

The western sneezeweed (*Dugaldia hoopesii*) has been shown to be the cause of the "spewing sickness" of sheep. The extended study of the subject was found to be quite complicated, but it is now nearly completed. A glucosid has been separated, which is the cause of the disease, and its pharmacology has been studied. The pathological results of the poisoning have been worked out.

An investigation of a heavy loss of sheep on the Sevier National Forest in the summer of 1917 threw suspicion on *Gutierrezia diversifolia* (yellow weed), and feeding experiments confirmed the suspicion. It is now known that this plant, which is not ordinarily considered poisonous, may, under certain circumstances, cause heavy losses. The detailed examination of the plant is being carried on.

Astragalus diphysus, a loco plant which is common in southern Utah, Arizona, and New Mexico, has been supposed to be poisonous, but with no definite proof. In the past season it has been proved that it will "loco" cattle and horses, and it is thus added to the number of plants which are definitely known to be locoes.

Asclepias verticillata, the whorled milkweed, has been under suspicion for several years, but has not been generally recognized as a poisonous plant. Recent experiments have shown that it is exceedingly toxic and doubtless has been the cause of heavy losses, more especially of sheep. Not only have corral experiments been conducted on this plant, but the chemical examination is well under way.

It has been found that the lupines, of which there are a large number of species, differ in their toxicity, and there is reason to think that many of them are entirely harmless. To discover by feeding experiments which species are poisonous would be a long and tedious task. Therefore a chemical examination of the toxic principles in the lupines has been undertaken and progress has already been made. It is hoped by this means eventually to classify these plants in accordance with their toxicity.

Work on *Eupatorium urticaefolium* (white snakeroot or richweed), *Zygadenus* (death camas), *Hymenoxys ligutacfolia* (rubber weed), and Aconite has been continued. A preliminary examination of *Daubentonia longifolia* showed that this plant, which grows in Texas, is toxic.

BIOCHEMIC DIVISION.

The work of the Biochemic Division, under M. Dorset, chief, consisted principally of investigations concerning hog cholera, laboratory research work relating to meat products, studies of dips and disinfectants, and the preparation of tuberculin and mallein.

HOG-CHOLERA INVESTIGATIONS.

The investigative work on hog cholera has related to (1) methods of producing immunity from the disease and (2) modes of its spread.

METHODS OF PRODUCING IMMUNITY FROM HOG CHOLERA.

During the year the bean-extract-salt method has been used to prepare more than 100,000 cubic centimeters of serum, the object being to determine the practicability of the method. The clear

serum thus prepared was subjected to heat at 58° to 60° C. and tested for potency, after being treated with phenol. The test showed the serum to be potent, and it was then held for somewhat more than nine months, when it was again tested and found to have retained its potency without noticeable diminution. This serum will be held for still longer periods and again tested to determine the limits of its keeping qualities.

A number of studies have been made of the agglutinins of various beans, and the reactions of various bean extracts have been tested with blood from ten different species of animals. The results show that there is a sharp difference in the agglutination reaction of different animal bloods with the same bean extract. The navy-bean extracts which have been employed in the production of hog-cholera serum are also very powerful agglutinins for horse's blood.

Additional work has been done with the process for refining old defibrinated blood antitoxin by diluting it with strong solutions of sodium chlorid and heating. While this process necessarily results in some loss of antitoxin, we have been able by its use to convert old defibrinated blood antitoxin into a clear serum free of blood cells and bacteria.

Patents have been obtained covering both the preparation of clear serum by the use of bean extract and salt and the process for refining old defibrinated blood antitoxin. These patents are dedicated to the public, so that the Government or any of its officers or employees or any other person in the United States may use these processes without the payment of royalty.

In order to ascertain the effect of heating on infections that might be present in serum as it is drawn from hogs, and in order also to ascertain the effect of weak mixtures of phenol on such infections, a series of studies has been begun by adding various pathogenic bacteria to sterile serum prepared by the bean-extract-salt method. The serums were then heated and phenolized. Tests for the presence of the pathogenic bacteria were made at different stages. Part of the investigations have been completed, and it has been found that the tuberculosis bacillus in clear serum is destroyed when the serum is heated for 30 minutes at 58° to 60° C. Studies of the effect of phenol (0.5) on the tuberculosis bacillus in clear serum have shown that the bacillus appears to be attenuated in two weeks and in the experiments thus far carried out it was destroyed in four weeks. These results are not to be taken as indications of what would take place in the case of defibrinated blood antitoxin; the presence of large quantities of red blood cells in the latter case would tend to afford a certain amount of protection to the bacilli.

MODES OF SPREAD OF HOG CHOLERA.

Experiments described in last year's report have in many cases been repeated and increased in number. Thirty-four additional experiments to determine the length of time that pens remain infectious after the removal therefrom of pigs sick of cholera have been completed. The infection seems to die out quickly in warm weather (as a rule within 24 hours), whereas in cold weather it remains active

for an indefinite time, certainly several weeks. It is a matter of great importance to farmers to know when they may with safety restock their farms after an outbreak of cholera. Conditions in different parts of the country vary so widely that no generalization can be made from the experiments. It is clear, however, that the virus of hog cholera survives much longer in winter than in summer, and further experiments have been planned to be carried out on a number of widely separated farms to determine how long after the removal of all sick pigs it is safe to restock farms.

Repeated experiments with the carcasses of hogs dead of cholera show that the virus in such carcasses becomes noninfectious within a comparatively short time in the summer, while it survives for long periods (several months) in the winter.

It has been observed that meat from hogs dead of cholera and which contains the virus of the disease may retain the infection after passing through the process of curing by means of salt and saltpeter and after smoking. Observations have been made along these lines with meats from pigs in different stages of the disease, and while the indications are that the virus is more apt to remain active when the meat is taken from pigs in the late stages of cholera than when taken from early cases, it has been found at times that the meat taken from early cases may be infectious after curing and smoking. As there is a possibility that carcasses of pigs in the early stages of cholera, before the disease can be recognized, may at times get on the market, it is important for hog raisers who feed hogs on garbage and table refuse, in whole or in part, to see that such feed is thoroughly heated before being fed to pigs.

A series of experiments has been begun to determine the duration of immunity in very young pigs following simultaneous inoculation. The first series, which included 29 pigs a few days old, treated by the simultaneous method, was held for 5 months and then exposed to cholera. All these pigs were found to be immune at the end of that period.

During the fall of 1917 and again in the spring of 1918 much attention was given to the possibility of the conveyance of hog cholera by insects. These studies include investigations of hog lice, flies, mosquitoes, and other insects. Much valuable information has been obtained. In some cases cholera has been transmitted by means of flies. It is too early to express a definite conclusion on the relation of insects to the spread of hog cholera.

DIPS AND DISINFECTANTS.

The laboratory of dips and disinfectants received for examination 161 samples of stock dips, disinfectants, and miscellaneous materials.

During the calendar year 1917 there were sent out the following test outfits and supplies for making dips in the field: Seven hundred and ten test outfits for arsenical dips, and supplies sufficient to make 447,900 tests for arsenic; 63 test outfits for lime-sulphur dips, and supplies sufficient to make 11,700 tests of lime-sulphur dips; 28 test outfits for nicotin dips, and supplies sufficient to make 3,375 tests of nicotin dips. There were thus provided a total of 802 new dip-testing outfits, together with supplies sufficient to make a total of

462,975 tests. This is more than double the number of outfits and the amount of supplies sent to field inspectors in 1916.

A method for preparing and testing pure arsenious oxid has been successfully worked out and the details published in the *Journal of Industrial and Engineering Chemistry* (vol. 10, p. 522).

There has been devised also a method for the preparation of soluble starch which is used as an indicator in testing arsenical dipping baths. This new method appears to be as satisfactory as the one previously in use and at the same time less expensive.

A study has been made of the effect of sodium sulphid on anthrax spores, and it has been found that a 5 per cent solution, while ineffective in 5 hours, destroys the spores in 18 hours. A 10 per cent solution was ineffective in 2 hours but effective in 4 hours. The presence of organic material, such as blood serum, did not appear to influence the results.

DISINFECTION OF HIDES.

Studies of methods for disinfecting hides and tannery effluents have been continued. Further studies of the effect of heat upon anthrax spores in soak water from hides and skins show that as a rule momentary heating at 100° C. is sufficient to destroy anthrax spores, but in the case of certain highly resistant strains the organisms were not destroyed; one or two spores out of 500 or 600 in the heated effluent survived heat at 100° C. for 1 minute. Three minutes' heating at 100° C. was sufficient to insure sterility. Heating at 93° C. for 15 minutes destroyed the spores in all instances. Heating at 80° C. for 30 minutes greatly diminished the number of spores but did not destroy all of them. When the effluent was first treated with chlorin in the proportion of 50 parts per million and then heated at 80° C. for 30 minutes, all the spores were destroyed. Further experiments with chlorin for disinfecting soak water from hides showed that the amount required varied from 250 parts to 400 parts per million, the amount varying in proportion to the organic matter present.

In the disinfection of dried hides the work was confined entirely to the use of solutions of hydrochloric acid and common salt. In laboratory experiments it was found that 1 per cent of actual hydrochloric acid plus 10 per cent of sodium chlorid with 40 hours' exposure, and 2 per cent actual hydrochloric acid plus 10 per cent sodium ehlorid with 20 hours' exposure, rendered infected pieces of hide noninfectious for animals, although the spores were not always entirely destroyed. The number remaining alive, though noninfective, was extremely small when compared with the number used to infect the hides.

In principle it may be said that hides and skins can be subjected to treatment with hydrochloric acid and salt without injury, but it is necessary to adapt the method of disinfection to the common tannery practices. On a large scale in a tannery injury may be done to hides and skins by the hydrochloric acid and salt solutions if neutralization and washing are improperly carried out. The process appears to be reasonable in cost, although its relative economy in comparison with other processes when used on a large scale has not yet been ascertained.

RESEARCH WORK ON MEAT AND MEAT PRODUCTS.

THE PRESERVATION OF MEAT BY DRYING.

Although many vegetables and other foods are dried successfully, very little work has been done on the problem of drying meats. Work has been undertaken, therefore, to study the various methods used for drying other foods and to apply these methods to the drying of meats. The condition of the meat, both with relation to physical properties and palatability, has been studied. Work carried out in cooperation with the Bureau of Chemistry has resulted in dried meat which when mixed with dried vegetables has been used to form a "dried Irish stew" which is now being tested by the Army.

SUBSTITUTES FOR MEAT PRODUCTS FOR INDUSTRIAL PURPOSES.

Investigations have been undertaken with a view to conserving meats and meat products for food purposes by determining the amounts of such products that are used in industries and by developing suitable inedible substitutes. The field is large and it is impossible to cover it all from the beginning. The first investigation relates to the use of inedible animal fats for industrial purposes, including the use of edible lard oil as an ingredient of signal oil, which is largely for use in the hand lanterns of railway trainmen. Certain inedible oils may be used successfully as substitutes, yet they are for the most part unavailable in sufficient quantities. This problem is receiving careful study.

PREVENTING WASTE OF MATERIALS IN CURING MEATS.

Sugar, saltpeter, and common salt are used in the curing of meats. Both sugar and saltpeter are scarce and very important, the first for food, the other for use in the production of explosives and fertilizers. It has been found that when meats are cured in pickle, slightly less than one-half of the sugar, salt, and saltpeter is taken up by the meats, the balance remaining in the pickle. It is estimated that there are used annually in the curing of meats in the United States 13,700,000 pounds of sugar and 2,272,000 pounds of saltpeter, one-half of which ordinarily is lost during the process of curing. Studies are being directed particularly toward the salvage of the sugar and saltpeter which remain unused in pickle after the curing of meats, and toward finding a satisfactory substitute for sugar in meat curing.

TUBERCULIN AND MALLEIN

There were furnished to various Federal, State, county, and city officials 803,317 doses of tuberculin for testing cattle for tuberculosis and to officials, including the War Department, there were furnished 1,736,852 doses of ophthalmic mallein for testing horses and mules for glanders. These amounts represent increased production of 33 and more than 400 per cent, respectively.

The laboratory studies of tuberculin have been continued, and more than 2,500 doses of ophthalmic tuberculin in disk form, with 9,140 doses of intradermal tuberculin, have been distributed to field inspectors of the bureau for experimental purposes.

OTHER WORK.

The Biochemic Division has continued to carry on, in cooperation with the Insecticide and Fungicide Board, the examination of insecticides and fungicides intended for use in connection with the diseases of horses, cattle, sheep, swine, and goats. One hundred and three samples were examined, of which 58 were found to be misbranded. A considerable amount of work was done by inspectors of the bureau in assisting the board on this work.

A number of different substances believed to be of value for the treatment of animal diseases have been examined also.

ZOOLOGICAL DIVISION.

The investigation of parasitic diseases of animals and the study, collection, and determination of animal parasites have been continued in the Zoological Division, under B. H. Ransom, chief.

ROUNDWORMS OF SHEEP.

In the work at the bureau farm near Vienna, Va., where a study is being made of methods of handling sheep to avoid losses from stomach worms, successful results are being obtained under a plan by which the lambs receive no medicinal treatment, the treatment of the ewes and the rotation of pasturage being depended upon to prevent injury to the lambs by stomach worms. This method has served also to protect against trouble with other internal parasites as well as stomach worms. Complete freedom from stomach worms and other parasites has not been obtained, but the degree of infestation has been exceedingly slight. The investigations are being continued with a view of being able finally to outline a definite scheme or schemes for handling sheep that will be effective in preventing losses from stomach worms and at the same time will not be expensive or unduly troublesome.

TREATMENT AND CONTROL OF EXTERNAL PARASITES.

OX WARBLERES.—Observations and experimental work on ox warbleres were continued during the year, but the results were negative. The application of various remedies by dipping or spraying failed to protect cattle from infestation with these parasites.

CATTLE LICE.—Field observations were continued and several large herds of cattle were dipped for lice. The coal-tar creosote dips were found to be very effective in eradicating cattle lice when reasonably good water was used.

HOG LICE.—Several series of experiments were made with hogs infested with lice, and the results show that dipping is the most effective method of applying treatment. Medicated hog wallows and rubbing posts kept the number of parasites reduced so that they caused little or no damage, but neither of these methods resulted in complete eradication. Crude petroleum was used on the rubbing posts, and the wallows were medicated with coal-tar creosote dips, pine tar, crude petroleum, and bland oils. A one-half of 1 per cent solution of pine tar in the wallows gave the best results. Crude petroleum and coal-tar creosote dips proved to be more effective when

applied from an ordinary sprinkling can than when used in wallows or on rubbing posts.

HOG MANGE.—Experiments on the transmission of mange from one hog to another indicate that the disease spreads much more rapidly and certainly to healthy animals when they mingle with infested hogs than by any other method of exposure. The disease spreads rapidly from one animal to another when the hogs are confined in close quarters. A herd of hogs confined in a pen with an infected pig all contracted the disease within six weeks.

Closed dirty pens, previously occupied by infected hogs, appear to be dangerous as a source of infection for about two weeks during severe winter weather and for about 30 days during mild weather.

A herd of hogs with advanced cases of mange was taken from a pen and turned on alfalfa pasture. Within three weeks the lesions were healed and new hair had started to grow over the infected areas. The hogs continued to improve, and at the end of 2 months no symptoms of scabies were visible. At this stage healthy sucking pigs were turned in with the herd and they all contracted well-marked cases of scab.

Different methods of treatment have been tried but the work has not progressed sufficiently to warrant definite conclusions.

EAR TICKS.—A large number of cattle were treated with various preparations for ear ticks, but no better remedy was found than pine tar, 2 parts, and cottonseed oil, 1 part. A Farmers' Bulletin (No. 980) on ear ticks was prepared.

CATTLE SCAB.—Investigations and experiments on cattle scabies were continued, with special attention to sarcoptic mange. Results show that sarcoptic scabies of cattle can be eradicated by four dip-pings in lime-sulphur or nicotin dips. The interval between dip-pings should be 6 to 10 days. A Farmers' Bulletin (No. 1017) on cattle scabies was prepared.

ANTHELMINTICS AND TREATMENT FOR INTERNAL PARASITES.

Results of investigations concerning various remedies for internal parasites have been published in the Journal of Agricultural Research (vol. 12, No. 7). Investigations on this subject are being continued.

BLACKHEAD OF TURKEYS

Experiments in progress indicate that diet may be an important factor in influencing the susceptibility of turkeys to blackhead.

ZOOLOGICAL INVESTIGATIONS RELATING TO MEAT INSPECTION.

An extensive series of practical tests of various methods of curing products containing pork, with reference to those kinds prepared customarily to be eaten without cooking, has been finished, and based upon these tests and other investigations carried on in the Zoological Division, the bureau has issued specifications of methods that have been found to be destructive to the vitality of trichinæ. In order to safeguard the consumer of pork products customarily eaten without cooking from the danger of contracting trichinosis from such products, all meat-packing establishments under Federal inspection are required to follow these specifications.

MISCELLANEOUS INVESTIGATIONS OF ANIMAL PARASITES.

In further investigations on the life history of the common round-worm of hogs (*Ascaris suum*) it has been conclusively proved that the parasite requires no intermediate host. The eggs of the worm pass out of the body of infested hogs in the feces. When swallowed by a pig the eggs hatch in the small intestine and the embryos, aided by the circulation, migrate to various organs of the body, including the liver and lungs. Those which reach the lungs crawl up the trachea and down the esophagus and enter the intestine again. During these migrations the worms undergo considerable growth and development, and at the time they leave the lungs are several times their original size. When they finally return to the small intestine they settle down and develop slowly to maturity. In young pigs as well as in small laboratory animals a heavy invasion of the lungs by the young worms may cause pneumonia, with fatal results. It is not unlikely that obscure lung trouble in pigs, children, and other young animals may sometimes be the result of infection with *Ascaris* or closely related worms. Lambs and young goats have been found to be susceptible to infection with the pig *Ascaris*.

Evidence indicates that young pigs are more susceptible than older animals to infection with *Ascaris*, as well as being more liable to serious injury from the parasite. It therefore appears particularly important to protect young pigs from infection. The teats of the sow when soiled with the dirt of the pigpen are liable to carry numerous *Ascaris* eggs, so that pigs are exposed to infection during the act of suckling. It is, therefore, likely that greater care with respect to cleanliness of the sow and the places occupied by her during the farrowing and suckling periods will help to reduce the damage done to pigs by *Ascaris* infection.

A preliminary note on the life history of *Ascaris* has been published in the Journal of Agricultural Research (vol. 11, No. 8).

In cooperation with the Health of Animals Branch, Canadian Department of Agriculture, investigations have been made of the nematodes parasitic in the intestines of horses. Over 20 different species of these parasites have been found to occur among horses in the middle western regions of Canada and the United States. One species (*Triodontophorus tenuicollis*) has been discovered to be associated with ulcers of the colon, and is the apparent cause of these ulcers. These investigations, in connection with which are being conducted investigations concerning swamp fever, an important disease of horses of unknown cause, have not yet been completed.

Further work has been done relating to the gapeworm of chickens, with results thus far indicating that as chickens grow older they become less susceptible to infection as well as less liable to be killed by the parasite; that adult chickens are of little importance as carriers of the parasite, but that turkeys of all ages are highly important as a source of infection of young chickens.

The Zoological Division has cooperated with the War Department in various ways, such as supplying information to the Surgeon General's Office relating to parasites, identifying specimens of parasites, examining scrapings from the skin of horses suspected of mange, providing material for use in instructing medical and veterinary officers, furnishing plans of dipping vats for horses, and supplying

antigen for complement-fixation tests of patients suspected of hydatid disease.

MISCELLANEOUS DIVISION.

The work of the Miscellaneous Division, under A. M. Farrington, chief, relates to the personnel of the bureau and to veterinary education.

BUREAU PERSONNEL.

The numerous changes due to war conditions have brought about a heavy increase in the correspondence and other work relative to civil-service examinations for positions in the bureau, appointments to such positions, promotions, demotions, transfers, removals, the furlough of employees on account of military service, the conduct of employees as to efficiency, the acceptance of outside employment, and other similar subjects.

At the beginning of the fiscal year the persons in the employ of the bureau numbered 4,211. During the year there were 2,136 additions, made up as follows: Appointments, 2,044; transfers from other branches of the Government service, 30; reinstatements, 62. During the same period there were 1,126 separations from the service, divided as follows: Resignations, 756; deaths, 32; removals for cause, 8; transfers to other bureaus or departments of the Government, 30; all other separations, 300. This last item includes terminations of appointments by limitation or for administrative reasons exclusive of separation for disciplinary reasons. At the end of the fiscal year the bureau personnel numbered 5,221, a net increase of 1,010 over the number a year before. The total number of employees who have left the bureau for military service up to the end of the fiscal year is 325.

During the year nine civil-service examinations were requested and subjects and weights were furnished to the Civil Service Commission.

For the first time in the history of the bureau, women have been appointed to assist in meat-inspection work at the packing houses because men were not available. This plan has proved to be so successful that steps have been taken to establish a civil-service register of women eligible for appointment to such positions in the future. Women also have been employed, under the direction of the Dairy Division, in creating an interest in the manufacture of cottage cheese for the purpose of conserving the food supply and bringing to the attention of the public the importance of dairy products as a source of food.

VETERINARY EDUCATION

The year 1918 has marked a distinct epoch in the education of veterinarians for the Government service. In consequence of the war a large number have been employed by the War Department in the veterinary corps of the Army. On the recommendation of the War Department, with the cooperation of the Department of Agriculture, the Civil Service Commission, and the committee on intelligence and education of the American Veterinary Medical Association, it was agreed, beginning with the 1918-19 session, to raise the entrance requirements of veterinary colleges to two years'

high-school work, or seven units. This is to apply to colleges on the "well-recognized" or "accredited" list, whose graduates will be eligible for appointment either in the War Department or in the Bureau of Animal Industry. In many quarters it was suggested that high-school graduation be required, but in view of all circumstances this was considered too much of an advance at present.

Another phase of veterinary education has been developed by agricultural colleges increasing the number of veterinarians on the faculty and giving instruction for two years that is similar and equal to the first two years at accredited veterinary colleges. The facilities for giving this teaching have been investigated by representatives of this bureau in each instance, and five State colleges have been added to the list of accredited agricultural colleges. The tendency at present seems to be to follow the lead established by medical and dental colleges in eliminating private colleges in favor of State colleges or colleges operated under ample endowment.

The attendance at veterinary colleges has been diminished materially, largely because of the war. The dean of one of these colleges reports that owing to war enlistments he has lost 50 per cent of his faculty and 66 per cent of his students. The number of freshmen enrolled in all veterinary colleges in the country for the session beginning with the fall of 1917 was 338 against 637 for the preceding year, a decline of more than 50 per cent. When it is considered that the enrollment for the 1916 session was 50 per cent less than formerly, it is easily realized that there has been a great reduction in the number of men who desire to take up the study of veterinary science. The combined attendance at all the veterinary colleges was 1,841 against 2,661 for the former year. The number of graduates was 93 more than in the preceding year, or 867 against 774, the reason for this increase being that the senior classes were larger than usual, many students taking advantage of the fact that they could graduate after three years' attendance.

During the year it was found that one college failed to comply with the rules, and this one was removed from the accredited list. No additions were made to this list during the year. The difficulty of procuring an adequate faculty and the prospect of a diminishing number of students have caused four colleges to discontinue their sessions. One of these has been for many years the largest veterinary college in the United States. The number of accredited veterinary colleges is 17 in the United States and 8 in foreign countries.

OFFICE OF HOG-CHOLERA CONTROL.

COOPERATIVE WORK FOR CONTROL OF HOG CHOLERA.

The work looking to the control of hog cholera has been continued through the Office of Hog-Cholera Control, in charge of O. B. Hess, along the general lines adopted in 1917. From a limited number of counties in 14 States it has been extended to State-wide efforts in 34 States, the work in 30 of these States consisting principally of control measures. In California, Colorado, Florida, Georgia, Kansas, Ohio, Oklahoma, and Utah, in addition to control work, a veterinarian has been assigned in each State with the extension division of the agricultural college whose entire time is given to educational activi-

ties in the field. In Louisiana, South Dakota, New Mexico, and West Virginia the efforts are principally educational in character. The other States in which control work is being conducted are Arkansas, Alabama, Arizona, Delaware, Idaho, Indiana, Illinois, Iowa, Kentucky, Michigan, Mississippi, Montana, Missouri, Maryland, Nebraska, North Carolina, North Dakota, South Carolina, Tennessee, Texas, Virginia, and Wisconsin.

The total number of veterinarians engaged in the work has varied from 160 to 195. The number of investigations of reported outbreaks during the year was 38,046. The number of visits and interviews with farmers and stockmen was 371,792. The number of hogs treated during the year in connection with the work by bureau veterinarians, practicing veterinarians, and others cooperating was over 5,000,000.

The extension of the work involves the investigation of reported outbreaks of hog cholera, supervising and assisting in the treatment of infected herds, cleaning and disinfecting premises, establishing quarantine when necessary, and giving instruction and advice to farmers, stockmen, practicing veterinarians, and others concerning methods of prevention, treatment, and control of cholera.

DECREASE IN HOG LOSSES

The losses of hogs for the year ending March 30, 1918, were reduced to 3,002,018, as compared with 7,004,756 in 1914. These figures are equivalent to a loss of 119.9 per 1,000 in 1914 and 42.1 per 1,000 in 1918. The latter figure represents the lowest mortality rate in swine for 35 years, and present conditions as a whole point to a still greater reduction.

INCREASE IN STOCK ON FARMS

An important phase of the work has been to assist in formulating and applying State and Federal rules and regulations for the immunization and handling at public stockyards of stocker hogs intended for feeding purposes on farms, in order that they may be returned to localities where feed is available without danger of spreading infection. These animals are subject to reinspection from time to time, thus assuring safety to the feeder while the hogs are being finished for market.

Taken altogether the hog-cholera control work has been the means of adding many millions of pounds annually to the Nation's supply of pork products and represents a saving many times greater than the cost of the work.

OFFICE OF VIRUS-SERUM CONTROL.

The preparation and importation of viruses, serums, antitoxins, etc., for the treatment of domestic animals are supervised and regulated under the virus-serum act of 1913 through the Office of Virus-Serum Control, in charge of H. J. Shore. At the close of the fiscal year there were 82 firms licensed by the Secretary of Agriculture to maintain establishments for the preparation of such products for sale in interstate commerce. These licenses covered 141 different products. During the year 13 licenses were canceled. An increased

volume of products was prepared at licensed establishments, and the manufacturers made praiseworthy efforts to prepare these products in a more satisfactory manner.

The bureau has endeavored to bring about uniformity in the names of veterinary biologics as far as possible and also to have the management of licensed establishments clearly indicate on the labels of containers of the products the nature of the contents, the diseases or conditions for which the product is recommended, and simple, accurate statements concerning the dose in each instance.

HOG-CHOLERA VIRUS AND SERUM.

Virus and serum for use in the prevention of hog cholera form a large part of the volume of products supervised. The number of tests made to determine the purity of hog-cholera virus was 1,352. The number of tests made of batches of antihog-cholera serum was 5,368. There were inspected and admitted to the premises of licensed establishments 263,364 hogs and 2,814 calves, a total of 266,178 animals. There were rejected by bureau inspectors when presented for admission, including animals rejected on tuberculin test, 720 hogs and 7 calves.

The amount of hog-cholera virus collected for hyperimmunization was 66,157,939 cubic centimeters. The amount of hog-cholera virus collected for simultaneous use was 9,230,457 cubic centimeters. The amount of antihog-cholera serum collected was 271,402,530 cubic centimeters. Of the foregoing products, the following were destroyed when collected: Hog-cholera virus for hyperimmunization, 4,414,191 cubic centimeters; hog-cholera virus for simultaneous use, 303,658 cubic centimeters; antihog-cholera serum, 2,488,661 cubic centimeters; loss by refining, 71,995 cubic centimeters.

Marked interest is being shown by manufacturers in the preparation of clear, sterile antihog-cholera serum as distinguished from the ordinary defibrinated blood serum. This product is now being prepared in large quantities by several licensed establishments.

EXPERIMENT STATION.

The work of the experiment station at Bethesda, Md., in charge of E. C. Schroeder, superintendent, relates mainly to the study of diseases of animals, and has consisted, as in previous years, of independent investigations, investigations in cooperation with other divisions of the bureau, and the provision of facilities for other divisions to make observations on domestic animals under normal farm and field conditions.

INFECTIOUS ABORTION DISEASE OF CATTLE

The insidious, chronic character of infectious abortion disease militates against the rapid discovery of the facts on which its control and eventual eradication depend. During the year the earlier discoveries have been confirmed but no radically new ones made.

The available evidence regarding the habitat of the abortion bacillus indicates that it does not currently multiply or maintain itself elsewhere in the bodies of cattle than their udders and pregnant uteruses. In the nonpregnant uterus of an infected cow abortion bacilli persist from a few days to a few weeks after parturition or

an abortion. It has been proved that the bacilli may persist indefinitely in the udders of cows, and that their presence in this organ is associated in a large proportion of cases with their occurrence in the uterus and placenta at the time of parturition, even when the latter event is wholly unattended with physically observable symptoms of abortion disease. The only known and demonstrated sources of abortion bacilli which can be held accountable for the perpetuation and spread of the disease are the milk of cows with infected udders and the material passed from the vagina by infected cows shortly before, during, and shortly after either an abortion or a parturition.

By way of practical application of present knowledge of the disease the bureau advises that healthy cattle should not be exposed to the raw milk of cows which react to abortion tests, and reacting cows should invariably be removed to special maternity pens or stables some time before they calve, and kept there until all discharges from their vaginas have ceased. Cows which show even the remotest symptoms of a possibly approaching abortion should immediately be segregated. Abortion bacilli remain alive and virulent for remarkably long periods in aborted fetuses and afterbirth and discharges from the uteruses of infected cows.

TUBERCULOSIS.

Repeated tests were made of the potency and reliability of tuberculin manufactured and sold under Government licenses and permits. The tests proved that most of this product now on the market is satisfactory, and that the establishments which manufacture it may be divided into two kinds—those which produce tuberculin of constant potency and those which produce tuberculin of varying potency. As would naturally be expected, the tuberculin produced by the latter at times is below a reasonable standard.

Investigations on the control and eradication of tuberculosis among food animals continue in progress. The results obtained again emphasize that this destructive disease would decline materially in frequency if relatively simple precautions against its spread were more commonly and thoroughly understood and practiced by owners of live stock. The recurrence of the disease in cleaned herds, it seems, must be charged to other causes than insufficient disinfection of infected stables, as very little disinfection, in addition to thorough cleaning, is required to make a stable from which tuberculous animals have been removed safe for healthy animals. Thorough cleaning has been shown to be of greater importance than the use of chemical germicides.

Studies regarding the possible spread of tuberculosis by small rodents, such as rats and mice, are being continued, and are giving interesting results which promise to be economically valuable. Mice which have ingested tuberculous material are especially to be suspected as possible spreaders of tuberculosis, as tubercle bacilli multiply enormously in their bodies and are freely scattered with their feces.

TUBERCLE BACILLI IN MARKET CHEESE.

Tests on the occurrence of tubercle bacilli in cheese have shown that varieties of cheese which require some time to ripen before they are marketed rarely contain virulent pathogenic bacteria, while soft

cheese may be dangerously infected. After proof had been obtained that soft, fresh cheese was often contaminated with virulent tubercle bacilli of the bovine type (18 samples among a total of 131 were found to be infected), corrective measures were devised and enforced by the bureau. How effective these measures have proved may be judged from the fact that, since their enforcement, not one infected sample was detected among 122 samples of soft cheese tested. The total number of samples of cheese of all kinds tested by the station up to this date is 472.

KERATITIS IN CATTLE

An outbreak of keratitis, or ulceration of the cornea, caused much trouble among the cattle at the station, and a similar eye affection evidently prevailed in different portions of the country. Because of the rapid spread of the disease and the large number of cattle attacked it was at first believed to be virulently contagious, but subsequent observations did not support this belief. The trouble was easily controlled by a change of diet and by thoroughly wiping out the affected eyes daily for several days with an absorbent cotton swab saturated with a freshly made 1 per cent solution of silver nitrate.

MISCELLANEOUS WORK.

A large number of tests of various kinds were made in the course of the year, including tests of material from animals showing symptoms somewhat indicative of foot-and-mouth disease, and tests of alleged but worthless remedies for hog cholera.

A large number of small experiment animals were raised at an expenditure much lower than would have been required had they been purchased. As in past years, every available portion of the station's surface was kept under intense cultivation, with a saving of approximately \$15,000 in feed and forage bills.

EXPERIMENTS AND DEMONSTRATIONS IN LIVE-STOCK PRODUCTION IN THE CANE-SUGAR AND COTTON DISTRICTS.

Live-stock production work in the cane-sugar and cotton districts was begun in 1914 and is directed by a committee consisting of William A. Taylor, Chief of the Bureau of Plant Industry, chairman; B. H. Rawl, Assistant Chief of the Bureau of Animal Industry; and W. R. Dodson, director of the Louisiana experiment station and director of extension service, Louisiana State University.

IBERIA EXPERIMENT FARM.

The work has included investigations and demonstrations at the experiment farm at Jeanerette, La., and extension work throughout Louisiana. The Iberia Experiment Farm, which consists of 500 acres presented to the department by the State of Louisiana, has equipment for carrying on investigational and demonstrational work with horses, mules, beef cattle, dairy cattle, and hogs. Mules and draft mares have performed the labor on the farm and at the same time have furnished a comparison of their relative cost for farm work. It has been found that last year a mare earned on an average \$76.86 less than her cost of maintenance for the year. This differ-

ence must be made up by the value of the foal she produces if a mare is to have the same value for farm work as a mule. The cost of raising mules to $2\frac{1}{2}$ years of age was found in the case of four animals to be \$156.27 for a mule averaging 1,066 pounds.

A beef herd of high-grade Hereford range cows and native scrub cows, headed by a pure-bred Hereford bull, is kept for producing feeder steers and breeding heifers.

During the winter the steer-feeding experiment of previous years was repeated, using 80 steers and feeding them for 100 days. In this a comparison was made of different kinds of silage for roughage when used with cottonseed meal. It was found that the lot of 10 steers fed on corn silage made the largest gain at the least cost. The lots finished in the following order with respect to daily gain and low cost of gain: Corn and soy-bean silage; sorghum and soy-bean silage; corn, sorghum, and soy-bean silage; Japanese cane silage; whole cane silage; and cane top silage. The profits on the lots fed were in the same relative order, the corn silage making the largest profit and the cane tops the least. In a comparison of different quantities of velvet bean meal, ground with the pods, when fed in conjunction with sorghum silage, it was found that when 7 pounds was the average daily feed compared with $9\frac{1}{2}$ pounds that the cost was much less per 100 pounds and the gain practically the same.

Grazing and feeding experiments with hogs, begun the previous year, have been completed and new grazing tests are under way. In a 29-day feeding experiment composed of three lots of five pigs each, one lot received shelled corn and tankage, the second lot rice polish and tankage, and the third lot rice polish. The cheapest gain was made with rice polish alone, with the corn and tankage coming second and rice polish and tankage ranking third. In the grazing experiments with fall pigs, the best gains were made in corn alone, with corn and soy beans and corn and velvet beans close behind. Oats, barley, rye, sorghum, and bur-clover did not make gains that were at all comparable with the first-mentioned crops. In the grazing tests with spring pigs the best gains were made on corn, soy beans, and cowpeas, with corn and soy-bean stubble and red clover, corn and soy-bean stubble, and velvet beans ranking in the order given.

The dairy herd, which consists of 13 pure-bred cows and an equal number of grades, together with both grade and pure-bred calves, has been used for studies in milk production and for feeding and management studies. Velvet-bean meal, ground with the pods, was compared with cottonseed meal in a feeding trial of 80 days with two lots of four cows each. It was found that there was little difference in the quantity of milk, butterfat, or total solids produced under the conditions of this trial.

LIVE-STOCK EXTENSION.

Because of the adaptability of the soil to the growth of cane and cotton, many sections of Louisiana have made slow progress in live-stock production. As a means of bringing before the farmers the value of live-stock production, local demonstrations in the different branches of live-stock husbandry have been carried on in the different

parishes. This form of demonstration has been successful in pointing out economical and successful methods of handling live stock. There are employed in the work specialists in dairying, swine raising, beef-cattle management, forage crops, and marketing. During the past year these extension workers have devoted their time largely to emergency problems of production. Special assistance has been given to emergency campaigns. Short courses and lectures have been given and various publicity features have been inaugurated. Much time has been devoted, also, to rendering direct aid by means of demonstrations to beginners in various branches of work. The farmers' short courses throughout the State have been placed under the live-stock extension service and 144 sessions of short courses were held in 33 parishes, with a total attendance of 17,160 persons, or an average attendance of 119. A feature worthy of special mention was the assistance given by the beef-cattle specialist in the selection and purchase of 28,152 head of beef cattle for 155 different purchasers. These cattle came from the drought sections of Texas and were placed on Louisiana farms. It is estimated that approximately 40,000 beef cattle came into the State during the year, of which about 3,000 were pure-bred.

REPORT OF THE ACTING CHIEF OF THE BUREAU OF
PLANT INDUSTRY.

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF PLANT INDUSTRY,
Washington, D. C., September 24, 1918.

SIR: I have the honor to submit herewith a report of the work of the Bureau of Plant Industry for the fiscal year ended June 30, 1918.

Respectfully,

K. F. KELLERMAN,
Acting Chief of Bureau.

Hon. D. F. HOUSTON,
Secretary of Agriculture.

WORK AND ORGANIZATION OF THE BUREAU.

The Bureau of Plant Industry undertakes the study and economic solution of plant problems, especially in relation to crop production and utilization. These activities include the improvement of useful plants by breeding and cultural methods, the investigation of destructive plant diseases and the development of methods for their control, the introduction and acclimatization of new plants from other parts of the world, the extension of the use of valuable crops and the development of improved methods for their utilization, the determination of both agronomic and economic crop relationships, and the meeting of emergencies incident to crop production as they arise from time to time throughout the country.

Since the questions of maintenance or increase of production of staple food and feed crops assume unusual importance under war conditions, a considerable expansion in the field activities of the bureau has been necessary. In developing this work different divisions of the bureau have cooperated actively with other Federal and State agencies. The work of the bureau during the year has been carried on with the following organization:

- Laboratory of Plant Pathology.....Erwin F. Smith, Pathologist in Charge.
- Pathological Collections.....Flora W. Patterson, Mycologist in Charge.
- Fruit-Disease Investigations.....M. B. Waite, Pathologist in Charge.
- Investigations in Forest Pathology....Haven Metcalf, Pathologist in Charge.
- Citrus-Canker Eradication.....Directed by K. F. Kellerman, Associate Chief of Bureau.
- Cotton, Truck, and Forage Crop Disease Investigations.....W. A. Orton, Pathologist in Charge.
- Crop Physiology and Breeding Investigations.....W. T. Swingle, Physiologist in Charge.

Soil Bacteriology and Plant-Nutrition

Investigations.....Directed by K. F. Kellerman, Associate Chief of Bureau.

Soil-Fertility Investigations.....Oswald Schreiner, Biochemist in Charge.

Acclimatization and Adaptation of Crop Plants; Cotton Breeding.....O. F. Cook, Bionomist in Charge.

Fiber-Plant Investigations.....L. H. Dewey, Botanist in Charge.

Drug-Plant and Poisonous-Plant Investigations.....W. W. Stockberger, Physiologist in Charge.

Physiological and Fermentation Investigations.....R. H. True, Physiologist in Charge.

Agricultural Technology.....N. A. Cobb, Technologist in Charge.

Biophysical Investigations.....Lynnan J. Briggs, Biophysicist in Charge.

Seed-Testing Laboratories; Enforcement of Seed-Importation Act.....E. Brown, Botanist in Charge.

Cereal Investigations.....C. R. Ball, Cerealist in Charge.

Corn Investigations.....C. P. Hartley, Physiologist in Charge.

Tobacco Investigations.....W. W. Garner, Physiologist in Charge.

Paper-Plant Investigations.....Directed by C. J. Brand, Chief of Bureau of Markets.

Alkali and Drought Resistant Plant

Investigations.....T. H. Kearney, Physiologist in Charge.

Sugar-Plant Investigations.....C. O. Townsend, Pathologist in Charge.

Economic and Systematic Botany....Frederick V. Coville, Botanist in Charge.

Dry-Land Agriculture Investigations..E. C. Chilcott, Agriculturist in Charge.

Western Irrigation Agriculture.....C. S. Seofield, Agriculturist in Charge.

Horticultural and Pomological Investigations.....L. C. Corbett, Horticulturist in Charge.

Arlington Experimental Farm.....E. C. Butterfield, Assistant Horticulturist in Charge.

Gardens and Grounds.....E. M. Byrnes, Assistant in Charge.

Foreign Seed and Plant Introduction..David Fairchild, Agricultural Explorer in Charge.

Forage-Crop Investigations.....C. V. Piper, Agrostologist in Charge.

Congressional Seed Distribution.....R. A. Oakley, Agronomist in Charge.

Demonstrations on Reclamation Projects.....F. D. Farrell, Agriculturist in Charge.

Seed Stocks Committee.....R. A. Oakley, Chairman.

From September 1, 1917, to August 31, 1918, the changes in the personnel of the bureau were as follows: Resignations, 773; deaths, 6; transfers from bureau, 42; furloughs, 410; terminations of appointments, 819; making a total of 2,050 employees dropped from the rolls during that period. In the same period 1,944 appointments were made, leaving a net decrease of 106 in the total force of the bureau. On September 1, 1918, the numerical strength of the bureau was as follows: In Washington, 773; outside of Washington, 1,476; total, 2,249. The total number of employees in the bureau on the same date a year ago was 2,355.

The activities of the bureau during the year are outlined more or less fully in the 29 technical papers appearing in the *Journal of Agricultural Research*, 6 papers in the *Yearbook*, 37 *Farmers' Bulletins*, and 72 *Department Bulletins*, circulars, etc. Certain of the more striking results of the year's work, however, are here summarized.

PLANT BREEDING.

SUPPLIES OF EXTRA-STAPLE COTTONS.

Instead of the former very limited demand for staples $1\frac{1}{2}$ inches long or longer, industrial uses for extra staples have multiplied rapidly in recent years and must be met by increased production if

adequate supplies are to be available for our manufacturers. The automobile-tire industry has grown very rapidly to enormous proportions, and the importance of using the best raw materials in the interest of strength and durability of the fabric is acutely appreciated. The substitution of extra-staple cotton for linen and silk in aeroplane wings and balloon fabrics renders it still more necessary that an adequate production of these high-class raw materials be maintained in the United States, not only because it is dangerous to remain dependent on cotton from Egypt or other foreign countries, but because our natural conditions and the abilities of our farmers are most favorable to the development of special branches of the cotton industry. Cotton that formerly went to Europe from Haiti, Brazil, and Peru is now coming to the United States, but these supplies are likely to prove temporary and should not keep us from developing our home resources of long-staple production.

AN UPLAND LONG-STAPLE TO REPLACE SEA ISLAND COTTON.

The development of a remarkable Upland variety, called Meade, with lint closely similar to the Sea Island cotton in length and quality, may make it possible to maintain the production of extra-staple cotton in the Southeastern States. The Meade cotton is much earlier than the Sea Island and has yielded more than twice as much in alternate planting with Sea Island under weevil conditions. The fiber attains a length of $1\frac{1}{2}$ inches or more under favorable conditions. The crop is harvested in the same manner and ginned with the same machinery as Sea Island, so that the substitution causes no change in the customary methods of handling Sea Island cotton either at the gin or on the markets. It was sold at Savannah in 1917 on the same footing as Sea Island. The percentage of lint is low because the seeds are larger than in other varieties, but the percentage of oil is correspondingly high. Supplies of pure seed are being increased as rapidly as possible, enough for about 500 acres being available for the season of 1918.

LONE STAR COTTON.

The Lone Star variety, bred by this department in northern Texas, belongs to the general type of "Texas big-boll" cottons, with Triumph and Rowden. In competition with these the Lone Star has become the most popular sort in many districts of Texas, Oklahoma, and other States. It now figures largely in many centers of production, is very favorably known in the market, and generally commands a premium over other short staples on account of the superior fiber, a length of $1\frac{1}{2}$ inches often being attained under favorable conditions. The advantage to the farmer of a general substitution of Lone Star for other varieties in the districts around Greenville, Hunt County, Tex., has been estimated at about \$700,000.

The Lone Star variety is being made the basis of a special effort to extend the use of single varieties in entire communities in Texas and adjacent States. The Greenville community, where a cotton-breeding station has been maintained for several years by the Department of Agriculture, is serving as a center of interest and cooperation in maintaining the uniformity of the stock and producing supplies of pure seed in practical quantities.

ACALA COTTON.

A new variety called Acala, bred from a stock obtained about ten years ago near the town of Acala in southern Mexico, has attracted special attention in Oklahoma on account of its resistance to drought. Experiments have been reported in which all the varieties failed except the Acala, and also several tests in which the Acala yielded more than any other sort. It is earlier than the Lone Star and other varieties of the Texas big-boll type. In character of foliage and general appearance of the plants it is intermediate between the Texas big-boll cottons and the Durango variety, two other valuable types that came originally from Mexico. The staple of Acala is also somewhat intermediate, of excellent quality, from $1\frac{1}{8}$ to $1\frac{3}{16}$ inches under favorable conditions, and often sold at a premium of 2 or 3 cents above short staples. The problem of developing adequate supplies of pure seed has been intensified by the very severe drought of the season of 1917 in northern Texas and Oklahoma.

AMERICAN EGYPTIAN COTTON.

Some 16,000 bales (average weight about 500 pounds) of Egyptian cotton were produced in Arizona in 1917, and both fiber and seed sold at unprecedentedly high prices. It is estimated that the total value of the crop exceeded \$6,000,000. In 1918 about 85,000 acres, or two and one-half times the acreage grown in 1917, were planted to this crop, the Pima variety, originated by this bureau, constituting at least 80 per cent of the total acreage. The bulk of the crop is still located in the Salt River Valley, but considerable areas are being grown in the Gila, Yuma, Palo Verde, Imperial, San Joaquin, and Sacramento Valleys.

The scale of production attained by the Pima variety of Egyptian cotton (about 70,000 acres) has made it possible to institute a general comparison or contrast of the uniformity of this select stock with the diversity that exists in Egypt and in the imported stocks of Egyptian cotton. An expedition to Egypt for the special study of this subject was made in 1910 and a report published, showing that the deterioration and extra labor resulting from the contamination with the inferior "Hindi" cotton occasioned a net loss of several millions of dollars annually to the cotton industry of Egypt. The contamination was found to be general, most of the fields showing from 2 to 10 per cent of plants with definite Hindi characters, very conspicuous to the practiced eye.

All of the forms of diversity that were associated with the Hindi cotton in Egypt have been eliminated and no longer occur in the Pima variety in Arizona. The farmers are now supplied with a superior variety of Egyptian cotton, more uniform than any other commercial stock. One of the chief objects of experimental and breeding work with this type of cotton has been attained, and there is every reason to expect that supplies of pure seed can be maintained in communities where only one variety is grown. The establishment of a uniform type tends to disprove the theory of botanical writers that the Egyptian type of cotton originated from hybrids of Sea Island crossed with Upland and other tropical species.

The great expansion of the industry, the partial embargo which has been placed upon imports from Egypt, and the demand for cot-

ton of this type in connection with the military requirements of the Government emphasize more than ever the importance of maintaining an adequate supply of pure planting seed. The extension of the industry to new localities brings with it the danger of planting mixed or inferior seed and of resulting deterioration in the quality and uniformity of the product. To guard against this danger, cooperation has been continued with the associated growers in the Salt River Valley in roguing their seed-increase fields, and arrangements have been made for seed selection and increase in the Imperial and San Joaquin Valleys. It is desirable to make these new centers of Egyptian cotton production self-contained in this respect as soon as possible.

Selection has been continued with the Pima, Yuma, and Sakel-laridis varieties, the importance of breeding work with the last mentioned, which is the principal variety grown in Egypt, having been emphasized by the recent discovery of its peculiar suitability for certain military requirements of the Government. Hybrids have also been made among the different varieties, since it has been ascertained by the study of crosses between two varieties of Egyptian cotton that it is possible to obtain from hybrids between distinct varieties belonging to the same general type relatively stable and uniform recombinations of the desirable qualities of both parents. In this respect, crosses within the same general type are unlike hybrids between very different types, such as Egyptian and Upland, since all attempts to obtain stable varieties from these wider crosses have thus far been unsuccessful.

BREEDING DROUGHT-RESISTANT CROPS.

Improved and uniform varieties of sorghum, millet, alfalfa, and brome-grass especially adapted to the climatic and soil conditions of the northern and north-central portions of the Great Plains have been obtained by selection from mixed commercial stocks.

IMPORTANCE OF ELIMINATING MINOR ABNORMALITIES IN CORN.

Yields of corn are seriously reduced by the presence of abnormal plants. In any field of corn will be found a large number of plants that for one reason or another are practically sterile, and also many plants that die before reaching maturity. These unproductive plants present a large series of abnormalities, only a few of which have been made the subject of study. It has been found that these abnormalities are of all degrees of conspicuousness. There is, in fact, no well-marked line between normal and abnormal plants. While the more conspicuous abnormalities are eliminated by ordinary breeding methods, the great majority of troubles pass unnoticed, and since all the difficulties thus far studied have proved to be recessive they are carried along in hybrid condition, separating each year in a certain number of plants, with the result that yields are materially reduced. A method of breeding has been devised which should make possible the elimination of these numerous minor difficulties, and experiments have been inaugurated to test the value of this new method on a commercial scale.

SWEET CORN RESISTANT TO THE CORN EARWORM.

An effort is being made to increase the supply of seed of the variety of sweet corn resistant to the corn earworm announced in last year's

report and to determine its range of adaptability. Early-maturing strains have been isolated for the northern part of the region infested by the earworm.

FRUIT IMPROVEMENT THROUGH BUD SELECTION.

The improvement of fruits through bud selection has made excellent progress the past year, especially along certain lines. Notable among these features is the establishment the past spring of two experimental lemon groves. One of these is located on a ranch at Corona, Cal., in fulfillment of a plan which was developed several years ago, and the other is located on the property of the citrus experiment station of the University of California at Riverside. The planting at Corona consists of $11\frac{1}{2}$ acres; that at the citrus experiment station of 5 acres. Both of these experimental orchards are planted with progeny trees propagated from selected parent trees having the best production records in the performance-record blocks. For comparison with trees so propagated certain trees have been planted that were propagated from parent trees having inferior performance records. The trees planted in these two orchards are different strains of the Eureka, Lisbon, and Villafranca lemon varieties. The plan is to keep accurate performance records of these progeny trees for a series of years after they come into bearing.

From a commercial standpoint the bud-selection work has made great progress in California. As a result of this work the California Fruit Growers' Exchange established a bud-selection department, the object of this move being the supplying of reliable buds of superior strains of citrus varieties grown in California to citrus growers and nurserymen.

NEW HYBRID COWPEAS.

Extensive breeding work with cowpeas is being continued. This work, involving several hundred hybrid selections and introductions, has given several new sorts, viz, the Potomac, Arlington, Columbia, White Hybrid, and Buff, which are being grown in quantity for distribution. Hybridization work with varieties especially suited for food purposes has been increased to a very considerable extent. Extensive field work is being continued with hybrids, especially on the wilt and nematode lands of the Southern States. Two hybrid selections, unnamed as yet, and crosses between the Groit and Brabham varieties have been found highly resistant to both nematodes and wilt and are superior to other sorts for the production of seed and forage. These two selections are being grown in quantity for more extensive field tests in 1919.

NEW STRAINS OF TIMOTHY.

The work in timothy breeding is conducted in cooperation with the Ohio Agricultural Experiment Station, at Elyria, Ohio. Pure strains of timothies which give promise of being more valuable than ordinary timothy have been developed, and of some of these sufficient seed has been obtained for distribution.

IMPROVED VARIETIES OF SOY BEANS.

The increasing utilization of the soy bean as food and in numerous manufactured products has resulted in an increased public interest

in this crop and a consequently larger acreage. Field work with soy beans has been extended, especially in connection with the testing of improved varieties selected from numerous introductions from Asia. Much hybridization has been done, involving the crossing of the nonshattering smooth sort with standard commercial sorts.

Many of the most important varieties now grown are the result of the department's work and include several that have been recently distributed, viz, the Haberlandt, Virginia, Wilson-Five, Hahto, Biloxi, Black Eyebrow, Manchu, and Peking. The testing of varieties for food purposes has given a soft-boiling bean superior to any other tested. The Hahto is a variety especially valuable for use as a green vegetable. Breeding work is being continued with varieties of high oil and protein content and high forage and seed yield.

SORGHUM BREEDING.

Possibilities in the development of improved varieties of sorghum by breeding are clearly indicated. Owing to the great importance of this group of forage plants, especially to dry-land agriculture, particular efforts are being made to develop varieties that will be adapted to the wide range of conditions found in the Great Plains region.

BREEDING RUST-RESISTANT ASPARAGUS.

As a result of the substitution of resistant asparagus for the susceptible strains previously grown, the rust is rapidly being eliminated. The distribution of the improved strains has been extended to every asparagus-growing section in the country, including many commercial seed growers and State experiment stations. Early and late strains to suit different growers who wish to meet different market conditions have been developed.

INVESTIGATIONS OF THE QUALITY OF SEED.

EXAMINATION OF SEED SAMPLES.

During the year 16,838 samples of seed were received for test at the Washington laboratory and 11,349 at the five branch laboratories maintained in cooperation with State institutions. This is a somewhat larger number of samples than was tested in the previous year.

In the spring of 1918 seed of red clover and redtop was collected for examination for the presence of adulterants as well as to determine how fully the seed trade is complying with its agreement to label all field seeds with the percentage of pure live seed. This material will be examined and reported on later.

The enforcement of the seed-importation act has kept out of the country much forage-plant seed of poor quality, over 400,000 pounds of red-clover seed having been prohibited entry during the month of May, 1918. On account of the difficulties of trans-Atlantic shipment, imports of most kinds of seeds have fallen off, Canada bluegrass from Canada and winter rape from Japan being the only two items the imports of which have exceeded those of the previous year.

GOOD SEED OF IMPROVED WHEAT VARIETIES.

Interest increases in obtaining quality seed of productive varieties. Inspection of growing fields of such varieties has been accomplished

as follows: Kanred hard red winter wheat in Kansas; Iowa No. 404 hard red winter wheat in Iowa; Early Baart hard white wheat in Arizona and California. Seed from inspected fields is being eagerly sought in the States where grown.

Marquis, the leading hard red spring wheat, is now more widely grown than all other varieties combined. In 1914 it comprised only 4 per cent of the total spring-wheat crop in the principal States of Minnesota, North Dakota, South Dakota, and Montana. In 1917 it had increased to about 45 per cent, while in 1918 the proportion of Marquis in the total acreage of spring wheat in those States probably reached 65 to 70 per cent.

SEED POTATOES.

In the pursuance of a definite plan for seed-potato improvement, this bureau has taken initial steps to secure and develop high-grade seed potatoes which it is proposed to make available in small quantities to those desiring to start with a good strain. The method of procedure adopted was to secure the best strains of some of the leading commercial varieties in Minnesota and Wisconsin and to assemble and plant them at Grand Rapids, Minn., and Rhinelander, Wis. In the East an attempt was made to secure strains of high-grade seed stock from New York, Vermont, and Maine growers. These strains are being grown near Presque Isle, Me. Frequent inspections of the plats are to be made during the growing season, and all varietal mixtures and weak or diseased plants are to be removed.

SEED OF RHODE ISLAND BENT-GRASS.

Efforts are being made to reestablish the Rhode Island bent-grass seed industry in New England. It appears that the saving of Rhode Island bent seed has been almost entirely neglected in this country. The seed which has been on the market under this name was either imported from southern Germany or else was redtop, but since methods of identifying the bulk seed of Rhode Island bent and redtop have been devised it has been possible to put a stop to this fraudulent practice of misbranding seed. It is intended to continue the investigations and to test various seed-harvesting machines.

SEED STOCKS COMMITTEE.

A committee on seed stocks has been organized to deal with existing emergencies due to inadequate supplies. As a result of the investigations by this committee it has been possible to bring about a better distribution of the seed supplies of the country by acting as a clearing house for information on supplies of and needs for seed. In cooperation with the United States Food Administration Grain Corporation the committee inspected large numbers of samples of seed wheat and in so doing assisted very materially in providing adequate supplies of spring-wheat seed for 1919. The committee also assisted in this connection by recommending to the Grain Corporation a plan whereby seed wheat could be held at points tributary to needy sections, with a view to supplying deficiencies in supplies of seed wheat for spring sowing. This resulted in the distribution by

the Grain Corporation of approximately 500,000 bushels of wheat in the spring-wheat area.

In the fall of 1917 the crop conditions of that year indicated that there might be an emergency in the supply of seed in parts of Texas, Oklahoma, Kansas, North Dakota, and Montana, and also in the northern part of the corn belt, where frosts and early freezes damaged corn to such an extent as to seriously reduce the available supply of seed corn. A long-continued drought in Texas made it appear advisable for the department to provide a considerable quantity of seed in order that that section's supply might be insured for the 1918 crop. After a careful consideration of the requirements, the sum of \$750,000 was expended for the purchase of seed corn, cotton, sorghums, and peanuts, to be held for such needs as might develop in Texas.

The conditions affecting the sorghum-seed supply in Kansas and Oklahoma threatened to cause a shortage of good seed for planting purposes, and the department expended \$215,000 for sorghum seed, including sweet sorghums, grain sorghums, and Sudan grass, for the purpose of supplying the needs of farmers who would have difficulty in getting seed from other sources.

In western Montana and eastern North Dakota the drought of 1917 was so severe as to cause almost a complete crop failure, and it became evident early in the season that farmers and commercial agencies would not be able to supply seed of various important crops for planting in the spring of 1918. The department purchased seeds of oats, barley, and flax for the general territory to the value of \$960,000, and shipped it to sections where it was most needed and where it could be made available to farmers under the terms of the law.

The supply of good seed corn in the northern part of the corn belt was seriously reduced because of unfavorable climatic conditions in the early fall and winter, and to assist in making adequate supplies available the department expended the sum of \$1,026,000 for the purchase and sale of seed corn to farmers for cash at cost. Approximately 55,000 bushels of seed corn were sold for first planting, and a reserve for replanting was purchased, but because of very favorable conditions for the germination and early growth of corn only a small proportion of the reserve stock was used.

In its war-emergency seed work the department supplied seed to farmers for planting upward of 1,000,000 acres, and it is felt that much good was accomplished not only in providing seed for acreage that would not otherwise be planted, but in supplying good seed to farmers at fair prices.

For the war emergency seed work a total of \$2,951,000 was expended.

AGRONOMIC AND HORTICULTURAL INVESTIGATIONS.

PRODUCTION OF CASTOR BEANS.

In midsummer, 1917, as the American aircraft program developed, this country was unexpectedly called upon to supply great quantities of castor oil for the lubrication of rotary aviation engines. It was estimated that several million gallons of castor oil would be

required for the lubrication of aircraft engines during the first two years of the war, while the available supply in this country was inadequate.

In September, 1917, the Secretary of War appointed a castor-oil production board to investigate the situation and to determine how the necessary supply of oil might be secured. This board comprised representatives of the Aviation Section of the United States Signal Corps, the Bureau of Plant Industry of the United States Department of Agriculture, the Export Bureau of the War Trade Board, and civilian experts. After the board had made its report the Signal Corps decided to contract for the planting of approximately 100,000 acres of castor beans in the southern part of the United States. Accordingly, castor beans were extensively planted in the following States: South Carolina, Alabama, Georgia, Florida, Mississippi, Louisiana, Arkansas, Texas, and California.

Planting was encouraged in the more southerly States for several reasons. Labor conditions in those States appeared to be more favorable than in those farther north, and it was believed that castor beans might to some extent replace cotton on lands where the ravages of the boll weevil had made the latter crop uncertain. Also, the planting of castor beans in the extreme South was expected to interfere least with the production of certain staple food crops.

A serious problem encountered early was that of securing a supply of seed sufficient to plant the large acreage decided upon. There was practically no visible supply of domestic seed, since the importation of low-priced castor beans from India prior to the war had practically destroyed an industry which once flourished in the States of Kansas, Missouri, Oklahoma, and Illinois. Since large stocks of castor beans grown for commercial use were known to exist in India, that country appeared to be the logical source from which to obtain the seed for planting.

The seed as received from India was found to be a mixture of several cultural varieties or types, and plans were accordingly made for a careful field study of these types during the crop season and for the selection of seed from the most desirable types for planting a crop next year, should this be necessary.

Since the castor-bean acreage was widely scattered over a number of States, many planters could not be reached in time to advise them regarding the selection of suitable soil and the methods of planting. As a result many plantings were made on soil which was too poor or too deficient in moisture for this crop. This condition was further aggravated by the wide circulation among farmers of baseless reports that the castor-bean plant would thrive well on the poorest soils and that it was practically immune from depredations of insects and attacks of plant diseases. Indeed, in some sections the planting of castor beans was actually discouraged by the circulation of reports that castor beans would ruin the soil for future crop purposes, that the plants were poisonous and would cause epidemics of disease, that the whole castor-bean program was German propaganda, etc. Notwithstanding the obstacles encountered, a large acreage was planted under favorable conditions and promises to yield a satisfactory crop.

Thus far during the growing season the crop has suffered some damage from various crop pests. Over a small area in Florida the

plants were affected by a serious root trouble apparently due to a species of *Rhizoctonia*. In several localities in Florida and Georgia some damage was occasioned by a wilt caused by *Bacterium solonacearum*, the brown-rot organism which produces the well-known wilting of tomatoes, potatoes, and tobacco. The cutworm has been quite prevalent in the castor-bean fields of some sections, and several other insects have inflicted minor injury. In Florida the fields have been attacked by the semitropical army worm, and already the crop on perhaps 1,500 acres or more has been totally destroyed. This is the most serious outbreak of this worm experienced during the last 12 years, and its general occurrence is a menace to the crop of the entire State. Both State and Federal authorities are giving all possible aid to the farmers in fighting the pest, and vigorous control measures are being taken wherever the worm has appeared.

The castor-bean program has had the active support of the Office of Extension Work of the States Relations Service, and many of the county agents have rendered effective service in this connection, for which they are deserving of credit.

It is still too early to forecast what the probable outturn of the crop will be. The very unfavorable weather conditions experienced in some sections have operated to increase the uncertainty. However, on much of the acreage the crop now gives promise of a favorable outcome.

DRY FARMING ON THE GREAT PLAINS.

While many problems are yet to be solved, the results of the experimental work of the past several years on the Great Plains are now authoritative on the fundamental questions of the adaptation of each crop to each section and the returns to be expected from its growth by all the different methods of cultivation likely to be employed. The surety of producing a crop or the hazard of failure, which is as important as the average yield, is also known. This information has been of immeasurable value in advising and directing endeavor, both individual and organized, in its effort to increase food production to meet the war emergency. It has also been the foundation of the assistance rendered the Geological Survey in its classification of public lands under recent homestead laws.

A long-continued series of experiments covering a wide range of soils, crops, and climatic conditions has conclusively proved that subsoiling does not generally increase average yields and does not afford any protection against drought. Neither is amelioration of dry-farming conditions to be obtained through deep tilling with dynamite or special plows.

In cooperative shelter-belt work with farmers on the northern Great Plains, active cooperation is now maintained with 507 farmers, who were furnished stock and planted shelter belts in 1916; 201 who planted in 1917; and 392 who are applicants for future planting. In 1916, 701,911, and in 1917, 357,700 trees were sent out. In 1916 the percentage of growth was 80 per cent, and in 1917 it was 81.2 per cent.

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COMMUNITY COTTON PRODUCTION.

That all cotton production should be placed on an organized community basis appears the more desirable with each additional season of experience in such efforts. The most direct and obvious advantage of uniting upon a single variety is that each farmer in the community can get more for his cotton than if many different kinds are raised. There is no question that large buyers and manufacturers will pay more for cotton of one kind that can be had by the hundreds of thousands of bales than for cotton that can be had only in small lots, with each farmer feeling at liberty to grow a kind different from his neighbors.

The result of mixing the seed of many varieties at public gins and of planting such "gin-run" mixtures of seed is a general and continuous degeneration of varieties. This can be counteracted only in a partial and temporary way by the breeding and distribution of seed of select stocks, which soon lose their purity and uniformity when grown in mixed communities.

The chronic deficiency of pure seed, even of the oldest and best-known varieties, is traceable largely to the lack of communities where seed of one variety can be grown without contamination. The advantages of community production of one kind of cotton and adequate supplies of pure seed have been demonstrated conclusively in the Salt River Valley of Arizona, which now has the largest body of uniformly pure cotton in the world. The first communities that were organized in different parts of the cotton belt are being utilized in the same way as sources of supply of pure seed for other communities that are beginning to organize.

War-time conditions are enforcing with many special reasons the general policy of more diversified farming and the need of each district producing its own supplies of food, as far as this can be done, but a fundamental relation of the cotton industry to other crops should not be overlooked. In humid regions the effect of the weevil is to compel or at least to encourage the replacement of cotton with other crops, but in the drier parts of Texas and the adjacent States the relative importance of cotton as the chief reliance of the farmer has increased during the period of weevil invasion, because the pest is less injurious in dry climates. While a large aggregate volume of other products is grown in the dry regions, cotton serves as the basic crop, being sufficiently reliable to keep the people on the land, so that the other ventures are made possible.

CORN GROWING.

Conclusive evidence has been obtained from several lines of work, proving that the productive power of a corn plant is influenced by the treatment received by the kernel from which the plant grew, from the time it ripened until it was planted. It has been common knowledge that injury to seed corn would reduce its germinability. These investigations have extended beyond germinability and determined the effects of seed treatment upon productivity independent of germinability.

A good stand may be obtained by the thick planting of poor seed, but with an optimum stand of plants from injured seed such plants are less productive than the same number from uninjured seed.

These results follow when the seed is injured by normal weather conditions as well as when injured by subjection to moisture, freezing, and thawing. Mechanical mutilations of kernels similar to the chipping, cracking, and breaking that to some extent take place in shellers and planters reduce the productiveness of the plants that grow from such kernels.

The point of value that has been established is that, independent of heredity and independent of germinability, any injury to dormant seed corn reduces the power of such seed to produce a good crop. Seed corn of 100 per cent germination, laboriously secured from injured seed by individual-ear germination tests, is less productive than seed that matured well and was so cared for as to make individual-ear testing unnecessary.

Tests under the same environmental conditions of widely dissimilar varieties have brought out the value in long-season districts of making plantings at different periods and using at least two varieties of different seasonal requirements in order better to meet the exigencies of the season and to insure a crop.

GROWING GRAIN SORGHUMS.

The grain-sorghum area increased from 3,944,000 acres in 1916 to 5,153,000 acres in 1917, or more than 30 per cent. Production increased from 53,858,000 to 75,866,000 bushels, or over 40 per cent. This largely increased quantity of grain was consumed through the ordinary channels without any undue drop in price. Farmers report excellent results from Dwarf milo and Dawn kafir, the varieties bred and distributed by the department, and the demand for seed increases. In Arizona and California Dwarf milo is grown successfully on irrigated land after barley is harvested, thus enabling the farmer to grow two grain crops on the same land in one year.

BROOM-CORN PRODUCTION.

Under the stimulus of high prices an increased acreage of broom corn was grown in 1917. Drought reduced the yield and quality and resulted in the highest prices known for many years. The production of this crop has been extended into new districts of southern Texas, especially under irrigation in the Rio Grande Valley.

SUGAR-BEET GROWING.

At the beginning of the fiscal year 98 beet-sugar mills were standing and equipped for making sugar. Two were built during the year, making a total of 100. Several new mills are in process of construction, some of which will be ready to handle the 1918 crop of beets.

Among the factors that are retarding sugar-mill construction are scarcity of material and scarcity of sugar-beet seed. These retarding influences are gradually being overcome, and the indications are for a marked advance in sugar-mill construction and in the development of new sugar-beet areas. Practically none of the existing mills were able to operate for a normal period of 100 days last year, for lack of raw material.

The domestic production of sugar-beet seed last year amounted to nearly 40 per cent of this year's planting requirement, and the quan-

tity produced in this country this year will be greatly increased. The yields of seed vary from 1,000 to 1,500 pounds per acre, with occasional yields much greater. The cost of production is being reduced, and there is every indication that a permanent seed industry has been established. It only remains to develop it until it is able to provide the total quantity of seed required by the beet growers of this country from year to year.

AGRICULTURAL INDUSTRIES ON RECLAMATION PROJECTS.

To aid settlers on Government reclamation projects to develop productive systems of agriculture, the work of several specialists is directed toward the promotion of the agricultural industries best suited to the conditions on the several projects. In general, the conditions of the different projects are shifting to a diversified agriculture in which live-stock agriculture occupies an important position.

PASTURES.

On those reclamation projects where the dairy and sheep industries are specially important, there is strong demand for information regarding feasible methods of maintaining dairy cows and small farm flocks of sheep during the summer months. In this connection the use of irrigated pastures is being encouraged and is receiving wide recognition by the settlers. The work of this bureau during the year in connection with pastures has been done principally on the Huntley, Shoshone, and Uncompahgre projects, and excellent results have been secured. A rapidly increasing number of farmers on these projects are planting pastures, and the great majority of them are succeeding in their efforts.

SUPPLEMENTARY FEED CROPS.

On several of the projects some difficulty has been experienced in the production of crops to use in supplementing alfalfa. The work in the production of supplementary feed crops has been done chiefly on the Truckee-Carson, Huntley, and Shoshone projects. On the Truckee-Carson project tests of several varieties and cultural methods of wheat, oats, barley, and mangels have been conducted in cooperation with farmers, and very satisfactory results have been secured. Preliminary tests have been successfully inaugurated on the same projects for the purpose of securing information as to satisfactory varieties and methods of production for silage corn, and some attention has been paid on the Huntley and Shoshone projects to the production of sunflowers for silage. This crop promises to have value as a silage crop on those projects where the growing season is short and where light frosts during early autumn make the production of silage corn somewhat hazardous.

IRRIGATION METHODS.

A field man has been stationed on the Umatilla project, in Oregon, where the topography is rough and the soil extremely sandy, to assist the farmers in developing satisfactory methods of land reclamation and irrigation. This work necessitates, in some instances, a complete readjustment of the farm irrigation systems and equipment, in order

to secure more efficient distribution of irrigation water. Improved methods of preparing land for irrigation and planting have been encouraged and have been adopted by a large number of settlers.

DAIRYING.

During the fiscal year 1918 demonstration work in dairying has been conducted on the Truckee-Carson, Huntley, Minidoka, Tieton, Shoshone, Boise, North Platte, Uncompahgre, and Belle Fourche projects. In this work the settlers have been assisted in securing stock, improving local dairy herds through breeding and cow testing, controlling diseases, planning and constructing barns and silos, and in improving their methods of feeding and marketing. A large volume of systematic cow-testing work is carried on. A number of bull clubs were organized, and much useful work was done in the local manufacture of dairy products. Owing largely to the efficient work which has been done with reference to the control of diseases affecting dairy cattle and to the resulting better understanding of these diseases by the settlers, the losses from contagious abortion and other ailments affecting dairy stock have been materially reduced. The work of encouraging the construction and use of silos made very satisfactory progress during the year, and a very large number of silos were built. Speaking generally, the dairy industry on the reclamation projects experienced marked improvement during the year. There was a decided tendency to reduce the size of herd, largely because of the difficulties of securing satisfactory dairy labor; but, on the other hand, a large number of farmers for the first time began to conduct dairy enterprises on a small scale, and owing largely to the increased prices for feeds there was a very marked increase in the appreciation of the necessity for using improved high-producing cows.

THE SWINE INDUSTRY.

Work in connection with the establishment of the swine industry is in progress on the North Platte, Truckee-Carson, Huntley, Minidoka, Tieton, Shoshone, Boise, Uncompahgre, and Belle Fourche projects. The settlers on these projects have been aided in solving problems of breeding, feeding, housing, and marketing their hogs and in the control of diseases affecting swine. The unusually high prices for feed and for pork resulted in a marked reduction in swine populations on most of the projects. This change consisted chiefly in a reduction in the size of herd, and this, in turn, resulted in a better utilization of waste materials and more economical pork production. Interest in high-class breeding stock increased materially, and there were marked improvements in housing facilities and methods of management. Chiefly because of the efficient educational work which is being done with reference to the control of diseases, losses from this cause were extremely small. The settlers are coming to a better understanding of the quarantine and sanitary requirements in the control of swine diseases and are acting more promptly than heretofore in this connection. As the result of the high prices and scarcity of the grains ordinarily used to supplement alfalfa in swine feeding and to finish hogs for market, special attention was paid during the year to the production and utilization of field peas in swine production. A number of cooperative tests were conducted

in this work with project settlers, and very satisfactory results were secured. In this work gains as high as 950 pounds of pork per acre of peas were secured. Attention was also paid to other crops which can be used as substitutes for the grain crops that have commonly been grown for swine feeding but which at present are not looked upon with favor for such use. This applies particularly to wheat, which heretofore has been widely used as a hog feed on a number of projects.

THE BEEF INDUSTRY.

The beef industry has received attention chiefly on the Minidoka, Tieton, Boise, Shoshone, and Uncompahgre projects. The settlers on these projects have been assisted in securing improved breeding stock, in improving their methods of feeding, and in the control of diseases affecting beef cattle. Special attention has been paid to the organization and conduct of farmers' associations for the cooperative use of the range lands adjacent to the projects. Cooperative grazing is now carried on by the settlers on the Boise, Minidoka, Shoshone, and Tieton projects. The cooperative marketing of beef stock was carried on successfully on a number of the projects during the year.

SHEEP PRODUCTION.

The high prices for mutton and wool have greatly stimulated the interest in sheep production by irrigation farmers. During the year perhaps more interest was shown in this industry than in any other live-stock industry. The chief work in connection with sheep production was done on the Minidoka, Truckee-Carson, Shoshone, Boise, Uncompahgre, and Huntley projects, where special attention has been paid to securing breeding stock for the settlers and to the cooperative marketing of lambs and wool. Attention has been paid to cooperative grazing on the Minidoka and Boise projects, and the settlers on these projects are now cooperating in grazing five bands of sheep on national forests. Good progress has been made in connection with the cooperative marketing of lambs and wool, particularly on the Boise, Minidoka, and Shoshone projects.

CROP UTILIZATION.

SWEET-POTATO STORAGE.

In connection with the emergency work a special campaign was carried on in the fall of 1917 in the Southern States in the storing and curing of sweet potatoes. The main effort was to induce the growers to build suitable storage houses for sweet potatoes. As nearly as can be determined, as a direct result of this campaign 166 storage houses, having a capacity of 700,000 bushels of sweet potatoes, were built, and 30 houses, having a capacity of 35,000 bushels, were remodeled. Because of the very severe winter, during which many sweet potatoes stored in banks were frozen, it is believed that the storage houses, which gave adequate protection against the cold, were of even greater value in conserving the crop than they would have been under ordinary winter conditions.

The experimental storage of sweet potatoes at the Arlington farm was continued, 45 varieties being stored, with a loss of less than 1 per cent of decay in a storage period of more than five months.

Twenty-three varieties had no decay, 9 varieties had less than one-half of 1 per cent, and 4 varieties showed a loss of more than 5 per cent.

Shrinkage weights were taken at harvest time (October 13), at the end of the curing period 13 days later, and at intervals during the storage period. Approximately one-half of the loss in weight takes place during the curing period. The rate of shrinkage does not vary much from month to month after the potatoes are cured. The average shrinkage for all varieties was 8.9 per cent on October 26, and 16.8 per cent on March 26.

FLAX STRAW FOR PAPER MAKING.

During the year special effort was made to solve the problems involved in using domestic flax straw for paper-making material. The investigations have shown conclusively that the tonnage of flax straw now estimated to be available can be greatly increased if purchasers will buy in small lots and not insist (as is now the custom) that straw for sale shall be baled. As a result of tests it has been demonstrated that flax straw spread 20 inches thick will ret so as to yield flax tow from which paper may be produced. By spreading the straw thickly in this way savings in land rentals and labor cost may be effected.

Recently 130 tons of flax straw were retted successfully in Minnesota and will be used in connection with paper-making tests. A complete experimental flax-tow machine is being installed at Dalton, Mass., in order to tow this straw. This machine has a capacity of about 5 tons of tow per day. Arrangements have been made to determine whether this flax tow may be used in the production of currency paper. Papers produced as a result of these experiments will be submitted to the Bureau of Engraving and Printing of the Treasury Department for examination in order to determine their suitability for currency. Flax papers made in the Washington laboratory of this project and submitted to the Bureau of Engraving and Printing were reported to be suitable for such use, owing to their wearing strength and printing quality.

FRUIT-HANDLING AND STORAGE INVESTIGATIONS.

The phases of the fruit and vegetable handling and storage investigations which have to do with commercial activities, including transportation, cold-storage warehousing, and other phases that are somewhat definitely of a marketing character, have been transferred during the year to the Bureau of Markets and are now being conducted there. In connection with the transfer of work, the members of the staff of this office who were directly connected with the carrying forward of these investigations were also transferred to that bureau. Some phases of technical research have been developed, however, which are fundamental in character and which have for their object the determination of the factors affecting the storage life of fruit and vegetables. This work includes within its scope not only the response of fruits and vegetables as living organisms to different storage conditions, but also the influence of cultural conditions upon

the subsequent behavior of fruits and vegetables when held under different conditions.

In connection with the storage life history of fruits, work on the internal browning of Yellow Newtown apples in the Pajaro Valley in California has been continued. While no definite conclusions have been reached as to the cause of the browning, it has been shown that apples from trees which habitually produce fruit with a tendency to develop the browning have a lower acid content and also a lower ash content than apples from trees in the same orchard which habitually produce fruit showing little or no tendency to develop the browning.

STOCKS FOR FRUIT TREES.

The fruit-tree stock investigations, which represent what we consider one of the most important phases of the fruit-production work, have received much less attention than their importance merits.

The past spring several hundred stocks each of French Crab, Myrobalan, and St. Julian plum, French pear, mahaleb, and mazzard cherry seedling stocks imported from France were lined out in nursery rows for use in connection with the fruit-tree stock work. Seeds in varying quantity of some 25 different species of *Pyrus*, *Malus*, and *Prunus* were also planted in nursery rows.

NUT INVESTIGATIONS.

The principal nut activities during the year were in connection with the pecan industry. While limited consideration has been given to the adaptability of different kinds and varieties of nuts to different regions of the country, this work has been largely incidental.

The pecan work has been prosecuted along three main lines, namely, an investigation of the range of adaptability of the species, the adaptability of varieties to different regions and conditions, and cultural problems. The first two features are mainly in continuation of work previously inaugurated. Another season's performance records of trees of bearing age representing several of the leading varieties in southern Georgia have been secured. Some small test orchards representing a number of different varieties have been established for the purpose of securing information in regard to the adaptability of certain varieties to particular regions within the recognized pecan territory, these varieties being such as have not been grown previously in the regions represented by the test orchards. Two of these test orchards are located well outside the generally recognized range of the species, at points where seeding trees planted a generation or more ago have given indications which seem favorable to the development of pecan growing in these regions.

The irrigation system which was started in an orchard in southern Georgia has been practically completed, so that applications of water can be made in case of drought.

POTATOES FOR STARCH.

In our studies on potato decay it has been found that the starch is not destroyed by the common decay-producing fungi or by freezing. In laboratory tests it is possible to recover most of the starch from frozen and rotten potatoes, which suggests that an attempt

should be made to salvage the great quantities of spoiled stock now rejected and dumped at our terminal markets.

PLANT PATHOLOGICAL INVESTIGATIONS.

BARBERRY PLANTS AND BLACK STEM-RUST OF WHEAT.

The campaign for the control of stem-rust of wheat through the eradication of the common barberry has aroused a widespread and effective sentiment against the shrub. This has resulted in the removal of the following estimated percentages of the plants located by the survey: Northern Illinois, 60 per cent; Wisconsin, 90 per cent; Minnesota, 80 per cent; North Dakota, 90 per cent; South Dakota, 80 per cent; Nebraska, 75 per cent; and Iowa, 75 per cent. The work has been well begun in the States adjoining those named. Safety lies only in the complete eradication of the common barberry plant.

RECENTLY DISCOVERED DISEASES OF CORN.

Work on the *Physoderma* disease of corn has shown this to be of economic importance in the more humid parts of the South Atlantic and Gulf Coast States. Study of the life history and distribution of the causal organism has been completed, and the results have been prepared for publication.

The study of the root rots and ear rots of corn has resulted in the isolation of several soil-infesting fungi which infect the corn plant. These organisms, producing rots in both root and ear, have been proved more or less active in causing low yields. One of the most virulent of these has been discovered to be identical with the fungus which causes scab of wheat, oats, barley, and rye.

SMUTS OF CEREALS.

A nation-wide campaign for the control of cereal smuts has been under way since September 1, 1917. Through cooperation with the States Relations Service, thousands of farmers were induced to treat their seed grain in the fall of 1917 and the spring of 1918. During the spring and summer of 1918 an extensive field survey has given much information on (1) the distribution of the various cereal smuts, (2) the losses caused by them, (3) the extent to which farmers treat seed grain to prevent smut, (4) a comparison of fields sown, respectively, with treated and untreated seed, and (5) the economic importance of other preventable cereal diseases.

ROTS AND SPOILAGE OF SMALL FRUITS.

Investigations of the rots and spoilage of strawberries, blackberries, dewberries, and raspberries were carried on in the field and market during the year. It has been found that a number of fungi may cause decay of these fruits in transit and distribution. The principal organisms are *Rhizopus*, *Mucor*, *Botrytis*, and *Patellina*. Studies of the temperature and moisture relations of these fungi in relation to the methods of picking, handling, and shipping have shown that the losses from these causes can be very greatly reduced by picking the fruit early in the day, even though wet with dew or rain. Careful

packing, handling, and ventilation have been found to reduce the losses to a minimum.

APPLE BLOTCH, SCALD, AND POWDERY MILDEW.

Observations on the distribution of apple blotch have shown it to be more widely prevalent than is usually supposed. On the other hand, in sections in which it was formerly very destructive, its destructiveness has been greatly decreased by spraying. Proper spraying through a term of years has practically eradicated the disease from orchards in which 10 years ago it was known to be very destructive.

It has been found that scald can be prevented by good aeration and that the completeness of this aeration is of much greater importance than its continuity. It is essential that the air movement be sufficient to break up the layers of stagnant air around the apples themselves. It has been found that in commercial storage scald can be prevented much more readily with apples packed in boxes or ventilated barrels than with those packed in tight barrels. It has been proved that scald is not due to an accumulation of carbon dioxid but to the presence of some other gaseous product of the apple.

The growing seriousness of powdery mildew has caused great concern among the apple growers in some of the irrigated sections of the Northwest. It has been found that complete control can be secured by the application of sulphur sprays early in the year.

WHITE-PINE BLISTER RUST.

It has been shown experimentally that the white-pine blister rust overwinters on currants. Successful inoculations on black currants were obtained with uredospores from currant leaves which had remained in a natural state in the open throughout the winter; also with spores from dry leaves which had been kept in the laboratory through the winter. These results confirm the wisdom of the quarantine against currants.

The rust on currants in Colorado and adjacent States, at first believed to be the white-pine blister rust, has been shown to be a relatively harmless native rust with its alternate stage on the piñon pine. This discovery has completely cleared up the situation in the far West with respect to blister rust, showing, with other results, that the far West is free from the true blister rust.

The situation regarding this disease may be summarized as follows:

(1) In New England and eastern New York the blister rust is generally distributed upon currants and is beyond hope of general eradication. It is being controlled locally by the destruction of the alternate host of the disease. Experiments are under way in definitely chosen areas to determine the cheapest and most efficient way of doing this.

(2) In New Jersey and Pennsylvania the disease is under control, having been eradicated in eight places. In New Jersey the disease has not been found this season. In Pennsylvania it has been found and eradicated in one place.

(3) In Ohio, Indiana, Michigan, Wisconsin, Minnesota, Iowa, and South Dakota the disease has been found at various times during the past six years in 71 localities. In 68 of these localities the disease has been eradicated and eradication is now in progress at the 3 remaining localities. The 71 localities are distributed by States, as follows: Ohio, 3; Indiana, 1; Michigan, 3; Wisconsin, 13; Minnesota, 49; Iowa, 1; South Dakota, 1. The disease has so far this season appeared in only one of the localities where it has been previously eradicated. It is believed that this record shows a substantial achievement and indicates that the disease can be confined to the East, at least for many years.

(4) In all remaining States the blister rust is yet to be found. This includes the States of Delaware, Maryland, West Virginia, all Southern States, and all States west of the Mississippi River except Iowa, Minnesota, and South Dakota. In all of these States an organized search for the disease has been made during the past two seasons.

CHESTNUT BLIGHT.

Several American chestnut trees have been located which are apparently highly resistant to the chestnut blight. This gives a promise of obtaining, by selection and propagation, a strain of American chestnuts which can be used for reforestation. Hitherto resistance has been found only in oriental species, which, while suitable for nut production, are too small for timber uses.

CITRUS CANKER.

Since the autumn of 1914 the bureau has been cooperating with the Gulf States in a campaign for the eradication of the canker disease of citrus fruit and trees.

Throughout the last three years great emphasis has been given to the necessity of unusual precautions and constant care to prevent the spread of canker, which is extremely infectious to all kinds of citrus trees. The progress of the work has been very satisfactory, and there appears to be no doubt that the few infections occurring in South Carolina and Georgia have been eradicated, so that further work in these States will not be necessary. The amount of infection in Florida, Alabama, Mississippi, Louisiana, and Texas has been very greatly reduced, and while very thorough scouting and inspection will be necessary in these States, in order to locate promptly scattered infections which may occur, it is believed that further seriously destructive outbreaks of canker can be prevented.

ALFALFA YELLOWS.

Studies on the "yellowing" of alfalfa are being continued in the East, with special attention to strains that are apparently resistant to this disease. Seed of a number of hybrids of *Medicago sativa*, Peruvian variety, and *Medicago falcata* has been sown in the West with a view to increasing stocks of the most resistant strains to the point where field tests can be made in the East.

TOBACCO DISEASES.

Investigations on "tobacco sick" soils in the Connecticut Valley, in Maryland, and elsewhere have fairly well established the fact that, in addition to the well-known *Thielavia* disease, there is involved in many cases a second parasitic root disease of tobacco which may cause serious injury to the crop under certain conditions.

As a result of cooperative investigations in Wisconsin a striking relationship has been shown to exist between the prevailing temperature during the growing season and the extent of the injury to the tobacco crop by the *Thielavia* root-rot. It has been shown that temperature is an even more important factor in this connection than rainfall. In relatively hot growing seasons the tobacco plant readily resists the parasite, while in cooler seasons the tobacco is much more susceptible to the disease.

As a result of further cooperative tests with growers in the Burley district of Kentucky it is expected that limited quantities of seed of Burley tobacco resistant to root-rot will be ready for distribution to growers for the next season.

It has been found that outbreaks of the leaf-spot of tobacco in Virginia and North Carolina, such as have occurred recently, are most effectively prevented or controlled by the relatively high topping of the plants, avoiding the use of land or fertilizers containing an excessive supply of nitrogen, especially in the inorganic forms, and using at least a moderate application of potash as a fertilizer.

In the investigations on the black-rot of leaf tobacco it has been found that the extent of the damage from this decay during the fermentation process usually is proportional to the water content of the leaf when packed, and a patent, dedicated to the public, has been secured on a process for standardizing the water content by partial drying under controlled conditions.

SUGAR-BEET NEMATODE.

The special investigation of the sugar-beet nematode inaugurated during the last fiscal year has received a marked impetus in combating the growing losses by the introduction of a new method for estimating nematodes in soil.

The results of surveys indicate that the losses suffered by growers in the State of California alone have risen from about a quarter of a million dollars in 1916 to more than four times that sum in the calendar year 1917. Examinations of samples of soil from some of the beet-growing areas of Colorado have revealed the nematode pest.

TOMATO DISEASES.

The control of the *Fusarium* wilt of tomatoes through breeding for disease resistance now seems assured. The occurrence of this disease is one of the principal limiting factors in the cultivation of tomatoes, as the fungus which causes it lives for an indefinite time in the soil and the larger part of the tomato-growing area east of the Mississippi is already infected. We now have an excellent commercial variety, a selection from the Stone, which appears to possess a high degree of resistance to *Fusarium* wilt in tests in a

large number of States. It has been distributed this season to a limited extent in all the States where the greatest losses occur and is being increased for larger distribution next year. Other varieties which are even more promising in disease resistance and which have been bred to fulfill special market requirements are being tested and propagated this year.

Previous efforts to control the Septoria leaf-spot of tomatoes, which causes losses amounting to several millions of dollars annually, by the use of standard Bordeaux mixture and ordinary spraying methods have given not only irregular results, but in the majority of cases unprofitable returns. A new resin-fishoil soap Bordeaux mixture applied by improved methods has given excellent results in the control of this disease and is being used by growers in a number of localities this year. In preliminary experiments in Florida Alternaria leaf-spot of tomatoes was successfully controlled by spraying with standard Bordeaux mixture. Investigations of the diseases attacking Florida winter-grown tomatoes, with particular reference to their development in transit to market, have shown clearly which of these diseases develop and spread in transit and thus where remedial measures must be applied for their control.

PATHOLOGICAL ADVISERS FOR COTTON, TRUCK, AND FORAGE CROP DISEASES.

During the year extension pathologists were located in 19 States.

The demonstrations on the control of cotton wilt, which have been in progress for several years, resulted last year in the planting of a larger acreage to wilt-resistant cotton than ever before, with an actual saving greatly in excess of that of any previous year. Two cotton planters in South Carolina report that their saving last year through growing wilt-resistant cotton was approximately \$115,000.

Demonstrations of methods of control of sweet-potato diseases in Accomac County, Va., last year resulted in a benefit to this county alone of about \$100,000, due to the application of the control methods. Special efforts were made during the bedding season this spring which resulted in the location and distribution of a considerably larger quantity of disease-free roots than would otherwise have been used for bedding purposes. A campaign for the selection of disease-free seed stock in the field and the storing of the sweet-potato crop under proper conditions is now under way.

A large saving to watermelon growers in central Georgia was effected last season through the assistance given them in the application of methods for the control of anthracnose and Diplodia end-rot, two important causes of deterioration in melons en route to market.

Seed surveys conducted in cooperation with other branches of the department resulted in the locating of considerable quantities of anthracnose-free beans and potato seed stock comparatively free from disease. Active work is now under way on the demonstration of methods for the control of potato late-blight and the location of disease-free fields for seed stock.

The facilities of the extension organization have also been used in the distribution of the rust-resistant strains of asparagus, which have now been placed in the hands of the county agents in practically all the asparagus-growing States.

MARKETS INSPECTION WORK.

During the latter half of the fiscal year this bureau cooperated with the Bureau of Markets in the inspection of carload lots of perishable vegetables at terminal markets, to determine the cause of deterioration in food products and to seek means of preventing such losses. Pathologists visit the headquarters of the Markets Inspection Service and work with the inspectors, teaching them how to identify vegetable diseases and at the same time tracing diseased shipments to their origin, where the problems of introducing control measures in the field are taken up by the extension pathologists. An important feature of this work is the preparation of a handbook of vegetable diseases for the guidance of the inspectors.

In the short time since the beginning of this work much has been accomplished in the way of familiarizing the inspectors with the diseases of vegetables and the following up of cases of severe losses, such as black-heart in potatoes from the North-Central States and powdery dry-rot in potatoes from the Great Plains and Rocky Mountain States. Studies of pathological problems involved in the transportation and handling of fruits have also been undertaken in cooperation with the Bureau of Markets.

BLACK-CHAFF OF WHEAT.

Studies have continued on the biology of the organism causing the black-chaff of wheat, and numerous field observations have been made on its distribution. It occurred this year in many places in Iowa, Kansas, Nebraska, and the neighboring States. It has not been discovered east of Illinois.

Work is also in progress upon methods of prevention. The organism has been found to be quite sensitive to copper sulphate, and inasmuch as it is usually carried on the seed from one field to another it is thought that a seed treatment can be devised for holding it in check.

WILT OF THE CASTOR BEAN.

A disease of castor-bean plants has developed in Georgia and Florida, and studies of this have shown it to be due to the same organism as that causing the wilt of tobacco and other solanaceous plants. Castor beans, therefore, should not be planted on land known to be subject to the bacterial wilt of tobacco, potato, tomato, eggplant, or peppers.

PLANT PHYSIOLOGICAL INVESTIGATIONS.

INORGANIC REQUIREMENTS OF CROP PLANTS.

Work on the relation of calcium salts to the physiological availability of the mineral soil constituents has been continued, with results in harmony with those reported last year. The practical importance of a sufficient supply of some source of calcium, whether in the form of limestone, lime, or gypsum, in order to secure the value present in the other chemical soil constituents, is emphasized.

In view of the present interest in the potash supply, some attention was given to a study of the availability of the greensand deposits occurring in the Eastern States from Sandy Hook, N. J., to southern

Virginia. These deposits were used very extensively to improve the soil for more than a generation before the Civil War. Greenhouse experiments with wheat and red clover showed that although the greensand found in these deposits is slowly soluble in water under laboratory conditions, it is acted upon by the roots of plants and by other factors in the soil sufficiently to free the potassium required to make an excellent growth during the early life of the plant, the period during which potassium absorption is most active.

DROUGHT RESISTANCE OF CROPS.

During the year work on the water requirement of crops was continued at Huntley, Mont., Yuma, Ariz., and Chula Vista, Cal. The results indicate that the consumption of water during the winter period in the Southwestern Desert region is less than in the case of the same crop plants when grown during the summer period in the Great Plains region. A comparatively great crop return is obtained in localities where the temperature conditions permit the utilization of water in winter. Where the water supply is very limited it can, therefore, be utilized most economically by crops grown during the cooler months of the year. It is believed that the results of these investigations will be useful to irrigation engineers and agriculturists by enabling them to estimate the quantities of water required by different crops grown in different seasons of the year, especially in places where actual irrigation experience with a particular crop has not already been obtained.

CROP-INDICATOR VALUE OF NATURAL VEGETATION.

The methods worked out in these investigations have been put to practical application in cooperation with the Land Classification Board in classifying land under the grazing homestead act, and the natural vegetation has proved to be a useful criterion for separating land suitable for dry-land grain production from land which can best be utilized for grazing. Investigations in the arid portions of the Great Basin and the Southwest have progressed to the point where the character of the land can be predicted very accurately from the natural plant cover, and its value for dry farming and irrigation agriculture can be inferred.

LEAF-CUT, OR TOMOSIS, OF COTTON SEEDLINGS.

Further observations have been made on this peculiar disorder that very frequently lacerates and distorts the leaves of cotton seedlings and not uncommonly results in the permanent deformity of the plants by destroying the terminal bud. Thinning cotton too early invites more injury from tomosis, on account of the greater exposure of the young plants to extreme conditions. When cotton is thinned late the crippled plants are easily recognized and removed, leaving only the normal individuals. Lack of any indications of bacteria, fungi, insects, or other parasites being responsible for leaf-cut left the causes in doubt, but the seat of the disorder has now been traced to the oil glands. The smallest lesions consist merely of a dead oil gland with the adjacent cells penetrated and stained by dark material from the dead gland. The oil glands are affected in advance of the other tis-

sues, as the affected areas enlarge. Such an origin explains why the disorder may be restricted to cotton, the oil glands being a peculiar feature of the species of *Gossypium* and a few closely related genera.

PHYSIOLOGICAL REQUIREMENTS OF THE DATE PALM.

The experiments to determine the physiological requirements of the date palm have shown that under partial shade and with controlled humidity the rootings of offshoots give high percentages of success. The relation of offshoot production to a broad leaf area in the parent tree has been demonstrated, as well as the advantage of a high nitrogenous fertility in the soil.

Observations of the leaf growth of date palms in relation to current temperatures have brought out the fact that under the higher temperatures, involving low humidity and greatly increased transpiration, the water supply becomes the limiting factor governing growth; hence at this season increased irrigation and especial attention to the permeability of the soil and to maintaining by culture a proper soil mulch are indicated.

FERTILIZER STUDIES.

The enormous fertilizer consumption in the United States, amounting to upward of a hundred million dollars prior to the war, has in the course of the last few years undergone a decided change, not so much in volume of fertilizer consumed as in the composition of the fertilizing materials. This has forced a careful study of ratios of essential plant-food constituents on prominent and essential crops. Accordingly, small field plats for the study of fertilizers have been established at many points on different soils and under different agricultural conditions. The test fields now in operation are at Presque Isle, Me.; State College, Pa.; Norfolk, Va.; Florence, S. C.; Pecan City, Ga.; Putney, Ga.; Thomasville, Ga.; Monticello, Fla.; Orlando, Fla.; Ashland Wis.; and Scottsburg, Ind.

Special field tests have been conducted to determine the smallest quantities of potash as a fertilizer which will meet the requirements of the tobacco plant, more especially on the lighter soils of the flue-cured district. Marked responses have been obtained with only 24 pounds, and even as low as 12 pounds, of potash per acre. These applications have sufficed to prevent the appearance of the characteristic symptoms of potash deficiency which the plant shows when no potash is supplied in the fertilizer. It has been possible also to establish an appreciable difference between the sulphate and the muriate of potash in their action on the plant.

EXAMINATION OF MATERIALS OFFERED AS FERTILIZER SUBSTITUTES.

The unusual fertilizer situation has brought forth numerous fertilizer substitutes of more or less doubtful merit for which extravagant claims are made. Companies are organizing to exploit fertilizer materials concerning the value of which little is known, and it would seem that a very considerable increase in such test work is necessary. Several such products have been investigated and tested. Some of them are practically worthless and others of value entirely out of proportion to the price charged.

NEW CROP PLANTS AND CROP EXTENSION.

FIBER FOR BINDER TWINE.

Manila maguey, *Agave cantala*, has been growing in the Philippines many years, and sisal, *Agave sisalana*, has been introduced into those islands since the American occupation. The cultivation of these plants has been confined chiefly to areas near the coast, where the leaves could be soaked in sea water to soften the pulp and facilitate cleaning the fiber by hand. Cantala, or Manila maguey, was produced more extensively because the plants were more easily obtained and this fiber was more easily cleaned by hand. More than 14,000 tons of this hand-cleaned fiber were exported from the Philippines during the calendar year 1917. Its value for use in binder twine is greatly impaired because the salt from the sea water in which the leaves are soaked attracts crickets and grasshoppers, which destroy the bands while the bundles of grain are standing in the field.

Work carried on in cooperation with the Philippine Bureau of Agriculture during the year resulted in the introduction of the first really efficient machines for cleaning these fibers in the Philippines. One machine, with complete equipment, has been installed in Cebu, and another in Ilocos Sur, where the plants are most abundant. Both machines are doing good work. A third complete outfit has been ordered. The fiber growers in Cebu have formed an organization for the production of machine-cleaned fiber.

It is found that sisal is not only superior to maguey, as was well known before by manufacturers in this country, but that it is cleaned to better advantage by machines. Larger proportions of sisal are therefore being planted. A second introduction of a half million sisal plants from Hawaii has been secured. The use of machines for cleaning the fiber will permit the planting of sisal over large areas suited to its growth away from the coast.

Plantations for supplying leaves for the machines are being planned on a larger scale, and better methods for planting, cultivating, and harvesting are being practiced.

The work is now started under most favorable conditions for the development of sisal production on a large scale in the Philippines.

Work on the development of improved strains of sisal and henequen by methods of selection is being continued on an increasing scale in Porto Rico. Trial plantings of sisal and henequen have been made in the dry lands near Quebradillas, in northwestern Porto Rico, and also on Mona Island, where several thousand acres of unused land are apparently adapted to the production of these fiber crops. Propagating stock of these plants has also been furnished for experimental planting in Central and South America, with the hope of developing new centers of production that may become available as the increasing demand for binder-twine fibers exceeds the supplies from Yucatan.

HEMP-FIBER PRODUCTION.

The selection of hemp for securing and maintaining improved strains is being continued. Seeds of the strains that have been demonstrated to be of superior value are sent to growers who raise the seed commercially. This method has been followed during the last

five years, so that most of the hemp now grown in this country consists of these improved strains.

One of the most promising recent introductions is the Tochigi variety from Japan. A plat of this variety grown at St. Joseph, Mo., in 1917 gave an excellent yield of seed, especially on loess soil, and this seed was of good quality and high germination, notwithstanding three severe frosts before the plants were harvested. This season about 100 acres of hemp seed are being cultivated in Missouri.

Early-maturing varieties, chiefly of Italian origin, are being grown at Madison, Wis., in cooperation with the Wisconsin Agricultural Experiment Station. This is the third year of selection for some varieties, and the results give promise of the successful production in that State of seed of hemp fully equal to the Ferrara of northern Italy. Several acres of broadcast hemp for fiber are being grown by Wisconsin hemp farmers from seed of the Ferrara selection produced at Madison last fall.

The hemp growers of Wisconsin, organized and encouraged by the cooperation of the experiment station, increased their planting this year to 7,500 acres, compared with 7,000 acres last year, although the unfavorable market which was maintained by dealers and consumers until after the close of the planting season resulted in a total decrease throughout the country of about 10,000 acres from the record crop of 41,000 acres last year. Even this reduced acreage is more than double the average of the last 30 years, and it is all needed, for, with supplies from Russia and Italy cut off, the hemp mills not only of the United States but of the allies also must depend upon the hemp produced in this country. Foreign inquiries are being received, and it is reported that some American hemp has been sold for export, the first instance of this kind in half a century.

PASTURE INVESTIGATIONS

Cooperative investigations of permanent pastures are being conducted in Virginia and Tennessee. Seedlings for permanent pastures have been made in a number of sections of Tennessee. On the Cumberland Plateau and in the section known as the Highland Rim orchard grass and redtop make very good grazing provided the land is limed and acid phosphate is added. Similar work is being planned for the Coastal Plains region around Williamsburg, Va. The utilization of cut-over pine lands in the South continues to be a very important problem, and studies are being conducted with a view to determining the possibilities of these lands for live-stock production. Tests of a large number of grasses are being conducted with a view to finding species that will produce satisfactory pasturage for a considerable period of the year.

RHODES GRASS FOR SALT LANDS.

In the Imperial Valley of southern California Rhodes grass has been found to grow on soils too salty for alfalfa. The conditions there under irrigation are somewhat similar to the conditions where it is extensively grown in Texas.

NAPIER GRASS FOR FORAGE.

Reports from southern California indicate that Napier grass is proving a valuable forage there. In the fall of 1917 cuttings of

Napier grass were sent to several points throughout the Gulf States to test its adaptability to that section, where it is expected it should prove valuable as a winter silage.

EARLY OATS.

The value of early oats, particularly of improved strains, has again been demonstrated in the corn belt. The Albion, a white strain of Kherson developed by this bureau in cooperation with the Iowa station, is now extensively grown in Iowa and adjoining States.

WINTER FLAX.

Preliminary experiments with winter flax at many stations in the Pacific Southwest in 1917 and 1918 have given exceptionally promising results. Damont (C. I. No. 3), a pure-line selection of a northern variety, has been especially good. If needed, a considerable acreage in the irrigated valleys of the Southwest could be devoted to the winter production of flax.

FIG CAPRIFICATION.

The fig insect (*Blastophaga psenes*) has been successfully colonized on two caprifig trees in southern Georgia, located as a result of a survey of fig trees in this region. The mamme caprifigs passed through the winter of 1917-18 uninjured, and the insect multiplied abundantly in the spring crop, or profichi. Caprifigs from one of these trees were successfully used to caprify the crop of a large seedling fig tree of the Smyrna type, causing a crop to set for the first time in the history of the tree. From published reports and field investigations it appears that there are many such fig trees, of large bearing capacity, which regularly fail to set a crop. The reason seems to be that these trees are chance seedlings of the Smyrna type, requiring pollenization through the agency of the *Blastophaga* in order to mature a crop. Common or "mule" figs are also improved by the same process (caprification). The greater firmness and increased sugar content of caprifigged figs should assist in producing a fruit crop suitable for marketing in a fresh state. Breeding by selection of seedlings from caprifigged figs may be expected to develop types better adapted to the relatively humid climate of the South Atlantic and Gulf States.

PROPAGATION OF THE BLUEBERRY.

Important progress has been made in the domestication and improvement of the blueberry. Several bushes that produce berries three-fourths of an inch or more in diameter have been selected from about 20,000 hybrids that have fruited thus far in the testing plantation at Whitesbog, near Brown Mills, N. J. Only such plants are selected for propagation and distribution as possess fruit with small seeds and delicious flavor, as well as other desirable qualities, such as color, productiveness, and hardiness.

THE CAMPHOR INDUSTRY.

During the past year much attention has been given to the development of labor-saving machinery for use on the camphor plantations

of Florida. The leaves and twigs of the camphor tree, utilized in the production of camphor gum, have been successfully harvested from 2,000 acres of trees by means of the camphor-harvesting machine devised by this bureau. The labor cost of transplanting the young trees from seed bed to field has been materially reduced by the use of suitably modified transplanting machines. Under the usual conditions of planting camphor seed the germination is very poor. It has been determined that seed from which the pulp has been removed just before planting will produce approximately 20 times as many plants as an equal quantity of seed planted without having the pulp removed.

DISTRIBUTION OF NEW AND RARE FIELD SEEDS.

A distribution of new and rare field seeds was made throughout the entire United States, having for its object the dissemination of seed of new and rare field crops, seed of improved strains of staple crops, and high-grade seed of crops new to sections where the data of the department indicate such crops to be of considerable promise. Each package contained a sufficient quantity of seed for a satisfactory field trial, and the recipient was urged to use the seed, if feasible, for the production of stocks for future plantings. A report card and a circular giving full directions for the culture of the crop accompanied each package of seed.

Only seed of new crops or of improved strains of standard crops were distributed, including the following: Dakota-grown, Grimm, Kansas-grown, and Peruvian alfalfas; yellow and white sweet clovers; Brabham, Groit, and Early Buff varieties of cowpeas; feterita; Bangalia, Carleton, and Liberty (Kaiser) field peas; Natal grass and Rhodes grass; Dwarf Blackhull kafir; Kursk millet; Freed, Dakota Amber, Red Amber, and Sumac sorghums; Biloxi, Black Eyebrow, Ito San, Mammoth Yellow, Manchu, Tokio, Virginia, and Wilson-Five varieties of soy beans; Sudan grass; Georgia and Osceola varieties of velvet beans; and Acala, Columbia, Dixie, Durango, Holdon, Lone Star, and Trice varieties of cotton.

During the year 218,918 packages of new and rare field seeds were distributed, including 79,585 packages of cotton seed. Gratifying results were obtained, indicating that by enabling a farmer to secure seed of new and improved crops in sufficient quantity to produce stocks for future seeding the crops of the country are gradually improved.

CONGRESSIONAL SEED DISTRIBUTION.

During the fiscal year 1918 there were distributed on congressional and miscellaneous requests 11,165,709 packages of vegetable seed and 2,188,818 packages of flower seed, or a total of 13,354,527 packages, each containing 5 packets of different kinds of seed. There were also distributed 12,473 packages of lawn-grass seed and 11,110 packages of improved narcissus and tulip bulbs. The seeds and bulbs were purchased on competitive bids, as heretofore. Each lot of seed purchased was thoroughly tested for purity and viability before acceptance by the department, and tests of each lot were conducted on the department's trial grounds to determine trueness to type.

REPORT OF THE FORESTER.

UNITED STATES DEPARTMENT OF AGRICULTURE,
FOREST SERVICE,
Washington, D. C., October 1, 1918.

SIR: I have the honor to transmit herewith a report of the work in the Forest Service for the fiscal year ended June 30, 1918.

Respectfully,

HENRY S. GRAVES,
Forester.

Hon. D. F. HOUSTON,
Secretary of Agriculture.

THE FOREST SERVICE IN WAR TIMES.

The war has profoundly affected the Forest Service. It has opened new opportunities, presented new problems, and made some old problems more pressing. It has emphasized the value of the work of past years, which provided indispensable foundations for meeting vital needs in the present crucial time. It has also led to the temporary abandonment of many of the old lines of work, the curtailment of others, and the assumption of large new responsibilities. There have taken place, in consequence, a readjustment and in some fields a radical reorganization of activities.

The demands of the Army for fighting men, the eagerness of our personnel (most of whom are of age for military service) to respond to the country's call, the special need of the Army for men qualified to undertake tasks of an unusual character for which the work of the Service has afforded preparation, the call of war industries and essential industries for similar men, the inevitable drain on the personnel created by the opportunities for much more lucrative employment in outside work, and the necessity of maintaining an organization capable of carrying on the activities which must be maintained as a part of the war effort, have all had to be accepted and adjusted to each other. How this has been done, and to what extent the Forest Service is meeting its responsibilities with the Nation in arms, this report will seek to make clear.

Two great fields of work are involved. That which will first be dealt with concerns the National Forests. Integrally related as they are to the economic life of the country and to the production of necessities never before so urgently required as now, their continued administration along lines which would prevent the breakdown of any essential necessity was an obvious duty. No less was it a public duty to release for use elsewhere all the man power that could possibly be spared.

The other important field of work concerns the best employment of the technical knowledge and equipment of the Forest Service for the furtherance of war preparations involving the use of forest products. The opportunities in this field have proved increasingly numerous and important. The demands of the Army, the Navy, and the war industries for assistance have been far beyond the capacity of the Forest Service to meet. In order to come as near as possible to meeting them, every available man has been taken from other work. All lines of investigation not concerned with war problems have been halted. The resources thus made available have been augmented by funds obtained from the War and Navy Departments. The entire energies of the Forest Service are now devoted to prosecuting the National Forest enterprise, as an essential war-time activity, and to aiding in the most advantageous employment of the country's forest resources generally for the winning of the war.

THE NATIONAL FORESTS.

RECEIPTS AND OPERATING EXPENSES.

The receipts from the National Forests in the fiscal year 1918 totaled \$3,574,930.07, an increase over 1917 of \$117,901.66.

While the grazing business produced an increase over 1917 of \$176,027.18, the timber business showed a falling off of \$58,965.79. In both cases war conditions were primarily responsible. For the sake of greater production of meat, hides, and wool the number of live stock permitted to graze on the forests was raised to the highest limit consistent with safety. On the other hand, the receipts from National Forest timber fell off because of the labor and transportation difficulties which confronted the operators in the Northwest, where the sales are heaviest.

The operating expenses of the National Forests have been for several years practically stationary at approximately \$4,000,000. These include only the cost of maintaining the regular protective system. Emergency fire conditions are met, if they arise, first by the use of the special emergency appropriation of \$150,000 and then, if this is not sufficient, by seeking deficiency appropriations from Congress. In the last eight years it has been necessary to seek from Congress four deficiency appropriations, aggregating \$2,081,543, while in three of the remaining four years the \$150,000 emergency item carried in the regular appropriations was supplemented by a second emergency fund which made available \$1,000,000 in 1912 and \$200,000 in 1913 and 1914. The total emergency expenditures for protection in these eight years have been nearly \$3,800,000.

It is becoming very plain that the present methods of protecting the great bodies of heavy timber in the most inaccessible regions should be modified. Not enough is spent on the regular protective system, and in consequence large emergency expenditures become necessary. To the cost of fighting the fires must be added the property losses which they inflict. The receipts from the forests are now not far below the operating expenses, and but for the disturbed conditions due to the war would unquestionably exceed them. With enlarged provision for maintaining the regular protective system the emergency expenditures to put out serious fires could be reduced

to a much lower level. It would be far wiser to put the funds which it is necessary to seek from Congress in the form of deficiency appropriations into the cost of keeping fires from becoming serious, through greater outlays for fire prevention, early detection, and swift concentration of fire-fighting forces. This subject is discussed in further detail under the subject of "Protection."

THE PERSONNEL SITUATION.

While private enterprises have had to accept increased operating costs as a result of the rise in the wage scale and in the price of materials due to the war, the regular expenditures of the Forest Service have perforce been limited to the amount appropriated by Congress. The weight of the burden has fallen largely on the personnel; with conspicuous and devoted loyalty the bulk of our force, outside of those who have gone into the Army or Navy, have chosen to stand by the Service, although they might almost to a man have obtained much better-paying positions elsewhere. This can not continue indefinitely, nor is it right that it should. The National Forest force is now underpaid, and its members are hard pressed by high living costs. Without relief, the standards of administration and protection are bound to deteriorate greatly and rapidly. Instead of being allowed to deteriorate they should be raised.

Even before the war the statutory salaries of a large part of the National Forest force were below what men of the same caliber and experience could readily obtain in private employ. That the turnover has not been larger has been partly because the work itself, with its opportunities for rendering real and valuable public service and the prestige and position of local leadership afforded, has appealed to many men as partial compensation for the relatively low pay. There has also been the hope and expectation that, with reasonable time, the Forest Service would be able to give promotions which would do justice to faithful and capable men. Further, the Service has been fortunate in the possession of an *esprit de corps* which has done much to hold its force together.

Nevertheless, in the last few years it has been increasingly difficult to keep the men. Restiveness in the face of increased costs of living and a wage scale based on the standards of eight years ago has tended to develop. In certain classes of positions particularly, the Service has been almost a training school through which men have passed to better-paying private employment. In general, the more responsible positions are filled by men who entered the Service when it was a young and rapidly expanding organization, and when they themselves were young and unencumbered with family responsibilities. Conscious that they have become more valuable with maturity and experience, and confronted with the necessity of providing for growing families, it is natural that many should turn to employment elsewhere when it begins to appear to them that their prospects of material advancement in the Service are doubtful.

This personnel situation has been much aggravated by the recent upward leap of living expenses and the great demand for men to fill outside positions which have resulted from the war. Local studies indicate that the cost of living has risen since 1914 approximately 60 per cent. Food supplies and clothing have in some localities

doubled and even more. The rise has been especially marked in the last two years. The forest ranger receiving \$1,100 or \$1,200, required as he is to own from one to three horses, finds himself, even with the greatest economy, unable to pay his essential bills. By taking work in the mines, shipyards, sawmills, or with live-stock companies he can do much better. The bulk of the men have remained at their posts, though scores have received outside offers of from \$200 to \$2,000 or more per year in excess of their Forest Service salaries.

The situation of the forest officers, clerks, and others having fixed bases of salary is very critical, and requires the earnest consideration of Congress. It has so far been possible to meet the drain upon the personnel by readjustments, by curtailment of certain work, and by employing as temporaries persons less skilled and experienced. The consequences have necessarily been felt at some points. It has not always been possible to maintain the same standards of service, and some constructive work of public importance has had to be given up. One instance occurred in 1917 on a Forest in Idaho. Practically the entire forest force had been replaced by relatively inexperienced men. It cost \$50,000 to put out fires that normally would have been quickly brought under control; and there was also a loss, in timber destroyed or damaged, of \$40,000.

The Forest Service has furnished to all branches of the Army and Navy 446 men. In addition to this a considerable number have left to serve in the War and Navy Departments in a civil capacity, and still others have resigned to take part in industries directly concerned in producing materials for war uses. Still others have been forced to leave the service because, with the low standard of salaries, they were unable to meet the constantly increasing cost of living. Since our entry into the war 1,179 persons, including those who have gone into the Army and Navy, have left the service. The reduction of the trained force by transfer to other branches of the Government for military work has constituted the normal contribution to the war. That practically the whole force did not enter such work has been due to the courageous patriotism of the men in remaining at their posts because requested to do so on account of the necessity to protect the public forests and maintain their essential activities.

One of the first calls made upon the personnel was in connection with the organization of the forestry troops by the Corps of Engineers. Two regiments of skilled woods and sawmill workers, comprising about 9,000 men and fully equipped with sawmills and logging appliances, were sent to France to produce from the French forests wood materials needed by the Army. The Forester was sent to France under commission to prepare the way for this work, and the Forest Service was called upon to cooperate in the recruiting of the forces. Altogether over 150 members of the Forest Service were taken for these forest regiments.

THE NATIONAL FOREST PROPERTIES.

CONTINUED DECREASE IN AREA.

The net area of the National Forests at the close of the fiscal year was 155,374.602 acres, as against 155,166,619 acres one year previously. The corresponding gross areas were 175,951,266 acres and

176,253,160 acres. Gross area includes all lands within the National Forest boundaries; net area excludes alienated lands.

On the face of these figures, an increase took place in the net area. This is much more than accounted for by the fact that in 1918 four National Forests—the Alabama, Shenandoah, Natural Bridge, and White Mountain—were proclaimed. These four Forests had a total area of 730,894 acres. Their proclamation, however, merely gave formal status as National Forests to lands already under administration and National Forests in everything but the name. They were four of the so-called “Purchase Areas” established in connection with the acquisition of lands for National Forest purposes under the Weeks Law.

In all, five of the Purchase Areas have become National Forests through presidential proclamation, the Pisgah having been proclaimed in the fiscal year 1917. All the Purchase Areas, however, are now under a form of administration identical with that of the National Forests. Since no change whatever accompanies or follows the formality of proclamation, the apparent net area increase due to this cause is obviously without significance. The real situation is more accurately expressed if all the Purchase Areas are included as National Forests. The statement then becomes:

Area of National Forests, including purchase areas.

Date.	Gross area.	Net area.
	<i>Acres.</i>	<i>Acres.</i>
June 30, 1918	176,504,232	155,927,568
June 30, 1917	177,145,548	156,060,007

In these figures the gross and net areas of the Purchase Areas are treated as identical. The Purchase Areas comprise (1) lands title to which has actually passed to the Government, amounting at the close of the year to 1,132,792 acres; (2) lands approved for purchase by the National Forest Reservation Commission and under process of acquisition, amounting to 509,011 acres; and (3) private lands which may or may not eventually be approved for purchase, amounting, as the boundaries are now drawn, to 4,646,435 acres. The boundaries of the Purchase Areas, however, are not strictly comparable with those of the western National Forests, which are fixed by presidential proclamation. They are tentative limits within which the commission will consider making purchases and may be modified at any time, and at present include much more private land than public. Hence in making up the above figures the Purchase Areas are regarded as including only the lands which have been actually acquired.

Prior to the fiscal year 1917 each successive year since 1909 showed a decrease in both gross and net areas. Compared with the total area when the Forests were at their maximum, early in 1910, the 1918 figures given above show a decline of about 18,000,000 acres gross and 16,000,000 net. This cutting down of the Forest areas has resulted chiefly from land classification. After nine years of steady sifting to separate from the Forests such lands as should not be permanently retained in public ownership, the task has, except in

Alaska, been brought substantially to completion. The existing Forests are approaching stability.

REASONS FOR DECREASE IN AREA.

The land classification idea lay behind the establishment of the Forests, but at first it had to be applied in a rough and ready way. The forested public lands were passing rapidly into private ownership, and there was no time for a refined classification. Hence the first decade of the twentieth century was the period of rapid area expansion, while close to another decade has been given to restudying the lands in order to determine just how much should be permanently held.

The act of June 4, 1897, after defining the purposes for which National Forests might be established, specified two classes of land which were not to be permanently retained, and provided for their disposition. Recognizing that the temporary inclusion of a certain amount of land more valuable for agricultural or mining development than for Forest purposes would necessarily attend the making of the reservations, the law authorized the Secretary of the Interior to restore such lands to the public domain "after due examination by personal inspection of a competent person appointed for that purpose." It also made mineral lands subject to continued location and entry. The act of June 11, 1906, authorized opening to entry lands within the Forests found to be chiefly valuable for agriculture. Study of the situation soon disclosed, however, that portions of the Forests should be eliminated for other reasons. A good deal of land had been included which, as its potential usefulness was weighed, was found unsuitable for National Forest purposes because its value to the public was too low to justify the cost of administration. In many other cases the Government-owned lands were too heavily interspersed with private holdings for advantageous administration. The bulk of the lands which have been eliminated from the Forests since 1909 fall within these last two classes.

While much of the area thus eliminated has agricultural value, as a rule the agricultural value, where there was any, was low. A relatively minor amount of agricultural land of excellent quality, usually in strips along the valleys of the larger streams, has been eliminated, while the forest homestead act has made it possible to deal with small patches of lands chiefly valuable for agriculture by listing them for entry as interior holdings. In the case of lands chiefly valuable for the minerals therein it has not been found necessary to provide for their development through eliminations, since the Forests are open to prospecting and mining development precisely as are the public lands. When a mining claim goes to patent the land is thereby classified as mineral, and this means of securing the development of such lands is all that is needed.

One other important class of land remains to be mentioned. As the National Parks policy has developed it has become evident that some portions of the National Forests have their highest value for permanent administration by the Government as National Parks. Some of the reduction of the area of the National Forests has been due to the enactment of legislation creating National Parks out of National Forest lands. The desirability of this course, where the

character of the attractions is such that administration of the lands as National Parks will result in their highest use, has been fully recognized by the Forest Service. Establishment of the fact that the highest use of the land will be secured by making it a National Park is in effect another form of land classification.

The reasons, then, for the reductions in area have been:

(1) To cut out of the Forests, through boundary changes, lands not important for National Forest purposes.

(2) To cut out, also through boundary changes, lands which could not in practice be successfully administered because of the large percentage of intermixed private holdings.

(3) To open to agricultural settlement lands which, although valuable for National Forest purposes, will serve their highest use as farms. This has been accomplished partly through boundary changes, but mainly through listing for settlement as interior holdings.

(4) To open to mineral development lands chiefly valuable for this purpose. This is brought about by the operation of the laws under which the Forests are open to prospecting and the locating and patenting of mineral claims.

(5) To make National Parks.

Underlying all of these reasons is the basic principle of determining the highest use to which the land can be put.

Such a determination is necessary to a right classification of the land. It can be made only in the light of a careful study of the potential value of the land for various specific purposes. To determine that it is chiefly valuable for forest purposes involves knowledge not only of what value it has for other purposes but also of the kind of use it will serve, and the public value of this use, under National Forest administration. Value for watershed protection, for timber production, for grazing, for recreation, for water-power development, and for various incidental uses must all be taken into account. Correct principles of land classification and a right application of these principles in dealing with specific areas are basic to successful development of the Forest properties.

PRESENT STATUS OF LAND CLASSIFICATION.

In the six years that have elapsed since the first special appropriation item for land classification became available, 150,579,380 acres have been covered by field examinations and the results embodied in reports and maps which have been submitted to and approved by the Secretary of Agriculture. Excluding the lands purchased under the Weeks Law and not subject to agricultural classification and homestead entry, the lands still unclassified total 24,609,499 acres, of which 21,013,205 are in Alaska. Of the 3,596,194 acres outside of Alaska still remaining unclassified more than 2,500,000 acres are in California. Much of the field work on all the lands still remaining unclassified has been completed and maps and reports embodying the results were in course of preparation at the close of the year. Before the close of the current year it is expected that the work will have been brought to substantial completion, except for the two National Forests in Alaska.

On these two Forests work was begun last year. In the Chugach it resulted in approval by the Secretary of Agriculture of the elimi-

nation of 307,800 acres, which will dispose of the chief agricultural land problem in the National Forests of Alaska. The proclamation making this elimination awaits final action in the Interior Department before its transmittal to the President.

ELIMINATIONS MADE DURING THE YEAR.

Eliminations totaling 894,077 acres were made during the year by presidential proclamations or Executive orders from 13 National Forests. At the close of the year there were pending in the Interior Department proclamations providing for the elimination of 1,016,923 acres more.

There was also eliminated, through final approval by the Interior Department, 133,335 acres of State selections in the Kaniksu Forest and 5 acres in the Harney Forest. These eliminations were due to land exchanges with the States of Idaho and South Dakota.

An apparent reduction of 129,082 acres resulted from recomputations of the area of a number of Forests, disclosing errors in the figures previously reported.

ADDITIONS DURING THE YEAR.

Hand in hand with the cutting down of the Forests, a movement in the opposite direction has taken place. It has the same basic purpose—to provide for the highest use of the land. Established as the National Forests were and had to be, without close study of the best boundaries or waiting for a mature decision as to just what classes of land would eventually prove suitable for permanent administration, they left outside in many cases areas of public land the addition of which is equally desirable with the elimination of unsuitable lands. Further, it is now fully recognized that the Government should extend its holdings through the acquisition of private lands.

New lands are added through (1) presidential proclamations incorporating in the Forests suitable areas of public lands, in the States in which Congress has not prohibited further action of this character; (2) acts of Congress, also making additions from the public lands; (3) purchases, under the Weeks Law; and (4) land exchanges.

In addition to the proclamations already mentioned which established the Alabama, Shenandoah, White Mountain, and Natural Bridge Forests from lands already acquired and under administration as purchase areas, three proclamations were issued making additions to the Forests from the public domain. The total area thus added was 93,017 acres.

No additions to the National Forest areas were made by act of Congress during the year.

The purchase of 185,199 acres under the Weeks Law was approved by the National Forest Reservation Commission during the year. Of this, 997 acres are in Arkansas. The extension of purchases to that State marks a new departure; previous action had been confined to the White Mountain and Southern Appalachian regions. The lands to which title was actually acquired totaled 171,940 acres. There remains available for purchases under the Weeks Law nearly \$1,000,000.

Because of the war, acquisition of new lands has been temporarily suspended except for lands already approved by the commission or

for lands which block in with earlier acquisitions. The results already obtained through administration of the purchased areas, however, and the signal demonstration that has been made of the ability of the Government to obtain on favorable terms lands public ownership of which is advantageous, not only for the protection of navigable streams but also, and at the same time, for other National Forest purposes, point to the importance of a renewal of the forward movement when the war is over.

Exchanges of land are primarily for the purpose of consolidating the holdings of the Government. They can be made only as authorized by specific acts of Congress. Hitherto exchanges have been principally for State school lands. The first exchanges made were on the basis of equal area and value. Subsequently exchanges were provided for on a basis solely of equal value. Such exchanges as a rule result in an increase of acreage. Finally, the act authorizing exchanges on the Whitman Forest has provided for obtaining title to private lands whose owners take in return for the lands surrendered an equal value of National Forest timber. As the exchange policy already embodied in legislation is more widely applied considerable increases of the National Forest area from this source are probable.

On the whole, the movement for additions to the Forests is evidently growing stronger. This is due primarily to the demonstration of the public advantages realized through Government ownership and administration of the present Forests. The movement for establishing the Forests which culminated in 1909 preceded such a demonstration. It was checked because of the very natural doubt as to how the system would work in the long run, and because of strong Western opposition to what it was feared would prove an incubus upon local development. Because the western public has become convinced through actual experience that the Forests are not detrimental but beneficial to local development, a rising tide of public sentiment in favor of additions to the Forests is now beginning to make itself strongly felt. Evidence of this is recorded by the attempts made to secure additions through acts of Congress, in the seven States in which presidential additions are prohibited. A number of acts have been passed making such additions.

At first the primary purpose for which such legislation was sought was watershed protection; but it was not long before projects for a large number of additions were advocated for the sake of the benefit of range regulation. Toward such additions, both in the excepted States and in those where the President may still act, the position of the Forest Service has been that, where Government ownership and administration of range lands not valuable for timber production or water protection is desirable, legislation specifically authorizing administration for range control should precede. One such act is now before Congress. In the State of Nevada alone projects for proposed additions of grazing lands covering over 10,000,000 acres have been adversely reported on by the Forest Service in the absence of direct legislative sanction for including grazing lands as such in the National Forests. Unquestionably, the movement for adding grazing lands to the Forests would have gained much greater headway had it not been held in check by the unwillingness of the Service to give

its support to proposals of this character in the absence of explicit legislative authority for such a course. Further, it is not believed that the public-lands grazing problem can be solved in this way. Adding individual areas to National Forests would be at the best only piecemeal disposition of a great problem which should be handled through general legislation.

Of late, new impetus has been given to the movement for additions by the growing realization of the all-round value of the Forests as factors in promoting local development. Perhaps no better illustration of this can be found than the memorial of the State of Idaho to Congress, passed by a practically unanimous vote of both houses of the State legislature, for the inclusion in the National Forests of what is known as the "Thunder Mountain Country." This memorial recites that the Thunder Mountain Country consists of approximately 1,120,000 acres of unreserved and unappropriated public land, of which not to exceed 1 per cent is agricultural in character; that nearly 350,000 acres has been swept by forest fires during the last 12 years, destroying approximately 700,000,000 feet of timber; that the mineral and water possibilities of the region are lying dormant and unproductive; that the wild life is being exterminated; that the grazing lands are being devastated by nomadic herds; and that the area is contributing little or nothing to the support of the county or State government or to the wealth of the surrounding communities. It then continues:

The inclusion of the said area within a National Forest would eliminate the annual destruction of timber by forest fires; make it possible for homestead settlers to secure title to their lands under the forest homestead act of June 11, 1906, without expense to them other than entry and final proof fees and without the necessity of awaiting public land surveys; would bring Federal aid in the construction of wagon roads, trails, bridges, and telephone lines; give adequate protection to the game animals, birds, and fish; establish a system of regulated range use, thus conserving and perpetuating the forage resources for the benefit of the local residents and taxpayers; make it possible for the State to realize upon its equity in the lands by relinquishing the unsurveyed school lands (secs. 16 and 36) and selecting more valuable lands elsewhere; increase the revenues of the county and State through the receipt of 35 per cent of the gross receipts collected by the Forest Service; enlarge the power of the State to share in the benefits of the Federal aid road act; and otherwise assist in opening to development and use the vast material resources of the Thunder Mountain region.

This addition should unquestionably be made.

PROTECTION.

Ever since administration of the National Forests began their protection against fire has been the greatest single problem confronted. Great progress has been made; effective methods of preventing, detecting, and suppressing fires have been developed; and yet the problem is by no means solved. On the contrary, it still remains the most difficult and perplexing of all administrative problems.

This is because of the peculiar conditions which make application of the system of fire control to the regions where fires are most dangerous a question of expediency in the use of limited funds and the choice of objectives. In other regions the protective system is adequate for satisfactory results because the development of improvements has progressed to a point which gives practically full

control. But where the country is still an utter wilderness, with scanty means of communication, no local population, and supply centers far away, quick action to put out fires before they gain headway is very difficult and the fighting of large fires very expensive. War conditions have introduced new elements into the situation and have increased the need for a restudy of the whole problem.

A disproportionately large fraction of the fire-fighting funds is spent on a few heavily timbered Forests in Montana, Idaho, Washington, and Oregon. The country is very rugged and mountainous, the number of lightning-set fires high, the climatic conditions such as to produce frequent seasons of great exposure to fires, and the character of the timber-growth favorable to their wide spread. Unchecked, fires in these Forests would do enormous damage. The National Forests in these four States have 37 per cent of the entire National Forest acreage, and 52 per cent of all the merchantable timber; but their fire-fighting costs in the four bad years 1910, 1914, 1915, and 1917 were 83 per cent of the total for all the Forests. Of this 83 per cent, four-fifths was expended on 20 of the 65 Forests in the four States, and two-fifths on a group of 7 adjacent Forests in which the situation is especially difficult.

These disproportionate expenditures are due chiefly to the frequency with which the fires reach so great a size that scores or hundreds of men must be gathered, transported, equipped, and maintained for days and even weeks on the fire lines, far within the Forests. The greatest fire hazard is in northern Idaho and western Montana, where immense resources remote from transportation and not now in demand are being held and protected for future use in the industries and development of the country. Here we still have almost a wilderness, with very few settlers in the forested areas and few men employed except in the lumbering and mining activities close to lines of transportation. There are wagon roads into only a very small proportion of the area and the system of trails is as yet incomplete.

This means that in the event of a forest fire too large to be successfully handled by the fire patrolmen stationed in the district, help can be secured only from distant points, and equipment and supplies must be packed in to the vicinity of the fire. Under such conditions the shortest time in which an adequate crew with equipment and supplies can be secured and got on the ground may be from five to seven days. By that time the fire may have spread, with unfavorable weather conditions, to such proportions that second and third calls for help are necessary before it can be brought under control.

Also, the incomplete system of roads and trails greatly increases the difficulty of quick movement when changes in the point of attack become necessary, and the lack of such facilities is often mainly responsible for inability to extinguish fires quickly and for a consequent large property loss.

The recruiting of large forces of fire fighters necessarily takes labor from productive industries, and their maintenance involves the consumption of supplies thus withdrawn from other use. As the war goes on it becomes more and more important to conserve both labor and supplies. War wages and war prices also heavily increase the Government's fire-fighting bills. It was difficult last summer to get

labor for the fire lines, and it will doubtless be much more difficult next summer. There is every reason for adopting, wherever possible, protective methods which will lessen the emergency occasions.

This danger can be lessened by increasing the regular protective force and putting it in the field earlier in the season. Last summer exceptionally early drought brought on a fire season of abnormal severity before the protective force was ready for it. Roads, trails, and telephone lines were still in process of repair to fit them for use again after the winter storms. The summer force of lookout men, patrolmen, and smoke-chasers was not fully organized and placed. While putting the protective force in the field earlier involves an increased expenditure in all years, in order to be ready for the exceptional years, the men can always be well employed, first in the repair and then in the construction of improvements.

With the present labor situation and need to avoid in every possible way the diversion of labor from those activities which are essential to winning the war, it seems a public duty to provide for placing an increased force of fire patrolmen on the Forests in sparsely settled districts, so that the need for drawing from labor engaged on other activities the men needed for emergency fire fighting may be reduced to a minimum. To do this will require an increased initial expenditure for patrolmen but in the long run it will result not only in a decreased expenditure for emergency fire fighting but also in a large decrease in the damage to the Forests and a big saving in man power.

Still more important is a recognition of the fact that the Forests can not be economically and efficiently protected against fires until they are well equipped with roads, trails, telephone lines, and lookout stations. Construction crews can be so distributed on the Forests and their work so timed that when fires break out they can readily be thrown into the fight. By attacking the fire problem, in the regions where it is most acute, along such lines as these it is believed that both the emergency expenditures and the use of man power can be materially cut down.

Both in 1917 and in 1918 exceptionally severe fire conditions had to be met. The first half of the calendar year 1917 was most favorable, but shortly after July 1 the situation changed rapidly. The usual summer rains failed, and a fire season developed which put the protective force of the Service to one of its severest tests. A deficiency appropriation of \$775,000 was necessary to meet the emergency expenditures.

The fire menace prevailed throughout the entire West, but, as in 1910, the worst fires were in the heavily timbered and sparsely settled Forests of northern Idaho and western Montana. In Montana the rainfall during the summer months was less than in any other year of record, and in Idaho it was less than in any other year except 1893 and 1910. Similar weather conditions prevailed in Oregon and Washington, and the fire hazard there was the worst since 1910.

In number, the fires of 1917 exceeded those of 1910, but the area burned over was only 749,377 acres, as compared with more than four million acres in 1910, and the estimated damage to the National Forests was only \$1,358,627, as compared with more than twenty-five million in 1910. This was due partly to the fact that the winds were

less violent, partly to improved organization and means of detecting and reaching the fires.

The following table gives further statistics regarding the 1917 fires. The largest proportionate increase over the previous year was in fires caused by railroads and lightning. This was due almost entirely to the extremely dry condition of the Forests and the consequent ease with which locomotive sparks and electrical storms started fires.

Fires on National Forests, calendar year 1917.

Extent and causes of fires.	Number of fires.	Percentage of total.
Area burned over:		
Under 0.25 acre.....	3,130	40.05
Between 0.25 acre and 10 acres.....	2,197	28.12
10 acres and over, damage under \$100.....	1,893	24.23
10 acres and over, damage \$100 to \$1,000.....	415	5.31
10 acres and over, damage over \$1,000.....	179	2.29
Total.....	7,814	100.00
Causes of fires:		
Railroads.....	1,003	12.84
Lightning.....	2,132	27.28
Incendiary.....	952	12.18
Brush burning.....	557	7.13
Campers.....	1,288	16.48
Lumbering.....	193	2.47
Unknown.....	1,365	17.47
Miscellaneous.....	324	4.15
Total.....	7,814	100.00

In the calendar year 1918 the fire situation has been critical from the very beginning of the season. An unusual drought prevailed in Arizona, New Mexico, eastern Oregon and Washington, northern Idaho, and western Montana. Ordinarily there is little danger in the Northwest prior to June 15, and the employment of many of the regular summer patrolmen begins on that date. In 1918, however, a serious fire, the extinguishment of which required an extra force of 250 fire fighters, started on the Coeur d'Alene Forest on June 10, before the regular patrolmen were on the ground. An equally bad situation developed in Arizona and New Mexico early in the summer, which required the employment of a large number of extra fire fighters during the month of June. With the funds depleted by an unusually bad fire situation during the last half of the previous calendar year, it became necessary to abandon many important projects, including planting and improvement work, in order that the money might be used for fire fighting.

The fiscal year closed with the fire situation exceedingly critical. Many dangerous fires were burning in the Forests of the Northwest, and an extra force of fully 500 fire fighters was engaged in fighting them. The fact that the agricultural appropriation bill had not passed, and the limitation of expenditures under the continuing resolution of Congress to one-twelfth of the previous annual appropriation per month, made it impossible to finance the fire-protection work in the usual way. In this emergency the President of the United States, at the request of the Secretary of Agriculture, made available \$1,000,000 from the national security and defense fund, it being

understood that a deficiency estimate will be presented to Congress for reimbursement of the amount actually expended. The cost of emergency fire fighting up to September 1 had reached the sum of \$575,000, with conditions still dangerous in several localities. It is therefore probable that a deficiency appropriation of at least \$750,000 will be required to cover the expenditures.

Observation indicates that the active educational campaign which has been carried on during recent years has brought the public to a realization of the importance of exercising the greatest care in the use of fire within both public and private forests, and that the number of fires caused by human agencies is being reduced. Although in a season like the last two a great many fires are bound to occur, it is a fact that the proportionate number of fires in the more thickly populated regions is gradually being reduced.

Cooperation with the different States under the special appropriation for that purpose, and with cities, counties, and the various fire-protective organizations, has clearly proved that fire fighting is war against a common enemy in which success is dependent upon a coordination of all the combatant forces. Most encouraging progress has been made in cooperative work. For example, in the State of California, through cooperation with the University of California, 412 local fire-fighting companies have been organized; 532 fire trailers, equipped with fire extinguishers or fire-fighting tools, have been installed at danger points; and 6,500 individuals are members of the rural fire-fighting companies. Similar results are being accomplished in other thickly populated regions.

An important form of protection of the National Forests is the prevention of loss from destructive insects and from tree diseases. Losses from these causes are great in the aggregate, although timber is seldom killed in large bodies. The largest and most valuable timber, which having reached maturity has less power of resistance than thrifty young trees, is most likely to be affected.

The Forest Service, in so far as the funds at its disposal will permit, has been conducting control measures in the more important areas of severe insect infestation, basing its activities on the technical studies conducted by the Bureau of Entomology. Uncertainties in regard to funds make it impossible to conduct work in every case on infestations at the time when the work would be most effective. The situation is often similar to that in the case of a forest fire, since a relatively small amount of work done while an insect infestation is small may prevent both a much heavier expenditure later, when the attack has grown to larger proportions, and a serious loss of valuable timber.

The importance of insect-control work is illustrated by the results of a study made in California in cooperation with the Bureau of Entomology and certain private owners of timberland. This study indicated that there is an annual loss of timber to the value of between \$200,000 and \$300,000 in this State alone as the result of insect infestation. It also indicated the areas which were most in need of control measures, and formed the basis for the work done in the spring of 1918 in cooperation with the National Park Service and the Bureau of Entomology. At the close of the fiscal year it was

evident that control measures should be continued in California, and also that there were infestations in parts of Oregon, Montana, and New Mexico, any one of which might develop into serious epidemics. These infestations are being closely watched.

MANAGEMENT.

TIMBER.

The lumber industry has been handicapped by the withdrawal of many of its skilled laborers for active participation in the war. The scarcity of experienced labor has been general. In some regions operators have been able to maintain or even to increase their production by using inexperienced labor in larger numbers than formerly; but the total cut of lumber in the country decreased about 10 per cent in the calendar year 1917 as compared with that in 1916. In spite of the marked decrease in general construction work, the demand for lumber for war uses has furnished a strong market to the operators and has enabled them to dispose of almost any material they could produce with the available labor.

This general condition reacted on the timber sale business of the National Forests to a less extent than might be expected. The total amount of timber cut in sales on the National Forests was slightly larger than in the previous fiscal year. Sharp decreases occurred in the cut on some Forests in regions where labor was most difficult to secure or where making the product involved the use of large numbers of laborers. These decreases, however, were offset by increased cuts in other regions where labor, though inexperienced, was abundant or where the most urgently needed war material could be produced. The more notable decreases were on the National Forests in Montana and Idaho, where labor was extremely difficult to secure; the greatest increases were in California, Arizona, and Colorado.

In a few sales the operations were suspended or greatly reduced. In one case all the officers of the purchasing company entered military service, and logging ceased. Some hewed-tie operators were able to secure so little labor that only a small fraction of the normal output could be cut. On the other hand, operators producing ship timbers, airplane lumber, box lumber, and sawed ties did their utmost to increase output of these products to replace the slackening demand for finishing and general construction lumber.

The amount of timber sold decreased sharply. Restrictions on the use of capital for development work, such as the construction of expensive logging railroads, prevented negotiations for the sale of large bodies of timber remote from existing transportation. Uncertainties in regard to future markets and labor supply led operators to be very cautious in undertaking long-term contracts, and there was a still more marked hesitation on the part of small operators who normally sell their entire output of logs or lumber under annual agreements. At the close of the fiscal year very few large sales were being negotiated, but a steady demand existed for small, fairly accessible bodies of timber, especially to meet the local needs of communities near the National Forests.

The timber resources of the Forests have been drawn on for a wide variety of products needed in the war activities of the Nation.

Sales of spruce and of other species suitable for use in airplane construction have been made with the object of meeting a specific war need, as have also sales of wood and bark from which tannic acid is extracted to be used in tanning leather for war needs. Sales of hewed ties, mine timbers, telephone poles, and other special products have helped to maintain the country's transportation facilities and production of fuel and metals. In a few cases it has been possible to furnish fuel needed at army camps, to be cut either by the army or by contractors. It is impossible to determine the proportion of the total cut on the National Forests which was ultimately used in war activities, but since the lumber industry has been very largely dependent for its market upon direct or indirect war orders, a large part of the cut on the National Forests unquestionably was so used. The total output of some sales, such as those of airplane material, was, of course, delivered to the Government. Even with purchasers who before the war produced construction lumber for the general market, it is probable that from 30 to 60 per cent of the output during the last year was sold directly or indirectly for use in the war program.

The Forest Service, in cooperation with the Bureau of Aircraft Production, has endeavored to stimulate the production of airplane lumber from Sitka spruce in every way possible. This species, however, occurs in commercial quantities on only a few National Forests, including the Olympic National Forest in Washington, the Tongass Forest in Alaska, and the Siuslaw Forest in Oregon. Every opportunity to purchase stumpage on these Forests was offered to operators, and a number of sales were made, aggregating over 40,000,000 board feet. Most of the spruce, however, is remote from transportation, although this situation will be somewhat relieved with the extension by the Government of the railroad along the north and west sides of the Olympic Peninsula. Some of the airplane lumber which was produced on the Olympic Forest was hauled to the railroad by motor trucks over distances as great as 30 miles. In Alaska the quality of the timber proved to be inferior to that in Washington, and although some satisfactory material for use in airplanes has been produced, it is now known that the best opportunities for production are in the State of Washington. The greater portion of the best spruce is in private ownership, as is also nearly all of the Port Orford cedar, of which two small sales for airplane lumber production were made on the Siskiyou Forest.

The agricultural appropriation bill for the fiscal year ending June 30, 1919, contains special provision for the granting of timber on the National Forests to any department, board, or committee of the Federal Government if the timber is to be used for war purposes. This legislation will enable a wider use of the timber resources of the Forests to be made in the prosecution of the war. Every opportunity for the effective use of this legislation will be made.

The sale of timber at cost of administration to settlers and farmers under the act of August 12, 1912, and the free use of timber resulted in the cutting of nearly the same amounts as in previous years. More settlers and farmers took advantage of the opportunity to purchase at cost than ever before, over 5,900 sales being made.

The reduction in the demand for large bodies of timber and the entry into the Army or Navy of many of the men who were previously engaged on the work prevented the continuation of timber estimating work on the same scale as in previous years. During the spring of 1918 the men who were available were concentrated on the areas for which estimates were needed as the basis for determining whether operations for urgently needed war material are possible. For example, during the spring and summer of 1918 the only work of this sort done in Washington and Oregon was on the west side of the Olympic Forest, where good estimates of the areas bearing spruce suitable for airplane lumber were necessary if the production of this munition is to be handled to the best advantage. Similarly, in the summer and fall of 1917 the work was largely concentrated on areas in which operations for ship timbers, ties, mining timbers, and pulpwood were anticipated. Several of these bodies of timber have since been sold.

The receipts from timber trespass were \$2,329.85, and from timber settlement \$99,500.62. Details regarding the cut and sale of timber and also regarding reforestation are embodied in the following tables:

Timber cut under sales, fiscal year ended June 30, 1918.

State.	Quantity (M B. F.).			Value.		
	Commer- cial.	Cost.	Total.	Commer- cial.	Cost.	Total.
Alaska.....	47,902	.....	47,902	\$74,767	.....	\$74,767
Arizona.....	74,274	349	74,623	164,902	\$349	165,251
Arkansas.....	13,166	158	13,324	40,426	119	40,545
California.....	100,380	2,293	102,673	205,225	1,596	206,821
Colorado.....	48,141	1,432	49,573	82,711	1,079	83,790
Florida.....	443	.....	443	797	.....	797
Georgia.....	371	.....	371	957	.....	957
Idaho.....	56,310	4,557	60,867	141,459	3,373	144,832
Michigan.....	90	.....	90	88	.....	88
Minnesota.....	12,076	.....	12,076	61,603	.....	61,603
Montana.....	68,704	7,246	75,950	158,958	5,863	164,821
Nevada.....	1,658	.....	1,658	2,751	.....	2,751
New Hampshire.....	2,354	.....	2,354	10,003	.....	10,003
New Mexico.....	46,728	392	47,120	108,280	373	108,653
North Carolina.....	1,910	.....	1,910	4,071	.....	4,071
Oregon.....	104,339	2,425	106,764	228,633	1,372	230,005
South Dakota.....	19,073	1,171	20,244	41,285	1,017	42,302
Tennessee.....	1,806	96	1,902	3,498	72	3,570
Utah.....	15,685	599	16,284	34,599	475	35,074
Virginia.....	3,932	23	3,955	8,782	20	8,802
Washington.....	67,433	411	67,844	93,335	209	93,544
West Virginia.....	3	.....	3	12	.....	12
Wyoming.....	20,404	489	20,893	44,682	383	45,065
Total, 1918.....	707,182	21,641	728,823	1,511,824	16,300	1,528,124
Total, 1917.....	706,681	20,858	727,539	1,491,207	16,096	1,507,303

Timber sold, fiscal year ended June 30, 1918.

State.	Quantity (M B. F.).			Value.		
	Commer- cial.	Cost.	Total.	Commer- cial.	Cost.	Total.
Alaska.....	83,314	.....	83,314	\$188,065	.....	\$188,065
Arizona.....	292,561	347	292,908	650,913	\$347	651,260
Arkansas.....	117,296	206	117,502	326,529	154	326,683
California.....	376,938	2,775	379,713	939,568	2,073	941,641
Colorado.....	98,368	2,547	100,915	162,091	1,935	164,026
Florida.....	401	.....	401	833	.....	833
Georgia.....	7,736	.....	7,736	30,764	.....	30,764
Idaho.....	66,265	6,487	72,752	172,657	4,889	177,546
Michigan.....	263	.....	263	173	.....	173
Minnesota.....	25,213	.....	25,213	87,527	.....	87,527
Montana.....	47,533	8,130	55,663	81,955	6,712	88,667
Nevada.....	2,383	.....	2,383	4,082	.....	4,082
New Hampshire.....	1,777	.....	1,777	6,275	.....	6,275
New Mexico.....	56,571	480	57,051	140,506	523	141,029
North Carolina.....	6,678	.....	6,678	23,001	.....	23,001
Oregon.....	34,706	3,429	38,135	76,800	1,893	78,693
South Dakota.....	25,598	897	26,495	57,391	796	58,187
Tennessee.....	1,335	203	1,538	3,044	154	3,198
Utah.....	13,829	954	14,783	31,722	746	32,468
Virginia.....	8,142	28	8,170	24,859	24	24,883
Washington.....	135,949	714	136,663	226,332	358	226,690
West Virginia.....	3	.....	3	12	.....	12
Wyoming.....	22,399	844	23,243	60,376	735	61,111
Total, 1918.....	1,425,258	28,041	1,453,299	3,285,475	21,339	3,316,814
Total, 1917.....	1,982,438	25,649	2,008,087	3,695,114	20,312	3,715,426

Number of timber sales, classified according to amount of sale, fiscal year ended June 30, 1918.

State.	\$100 or under.			\$101 to \$500	\$501 to \$1,000	\$1,001 to \$5,000	Over \$5,000	Total.
	Commer- cial.	Cost.	Total.					
Alaska.....	491	.....	491	3	1	9	4	508
Arizona.....	616	174	790	5	6	8	2	811
Arkansas.....	29	53	82	6	4	8	3	103
California.....	459	393	852	19	11	19	12	913
Colorado.....	615	322	937	16	14	18	7	992
Florida.....	11	.....	11	2	.....	.....	.....	13
Georgia.....	15	.....	15	.....	1	.....	1	17
Idaho.....	698	1,451	2,149	15	15	18	6	2,203
Michigan.....	10	.....	10	.....	.....	.....	.....	10
Minnesota.....	7	.....	7	3	4	8	6	28
Montana.....	811	1,813	2,624	21	5	9	2	2,661
Nevada.....	109	.....	109	2	.....	1	.....	112
New Hampshire.....	161	.....	161	1	3	1	.....	166
New Mexico.....	776	202	978	8	6	10	2	1,004
North Carolina.....	61	.....	61	1	1	3	1	67
Oregon.....	331	536	867	7	1	5	2	882
South Dakota.....	400	182	582	16	8	10	2	618
Tennessee.....	51	55	106	2	.....	.....	.....	108
Utah.....	521	486	1,007	17	3	3	1	1,031
Virginia.....	161	9	170	3	2	2	1	178
Washington.....	190	107	297	8	1	12	10	328
West Virginia.....	1	.....	1	.....	.....	.....	.....	11
Wyoming.....	146	124	270	5	3	3	2	283
Total, 1918.....	6,670	5,907	12,577	160	89	147	64	13,037
Total, 1917.....	6,615	4,686	11,201	139	83	107	78	11,608

Planting and sowing on National Forests, by States, 1918.

State.	Area planted.	Area sowed.	Total.
	<i>Acres.</i>	<i>Acres.</i>	<i>Acres.</i>
Oregon.....	1,236.20		1,236.20
Idaho.....	868.50		868.50
Montana.....	799.00		799.00
Colorado.....	773.62	106	879.62
Nebraska.....	697.25		697.25
Minnesota.....	696.25		696.25
Washington.....	320.00		320.00
California.....	171.60		171.60
Michigan.....	147.85		147.85
Utah.....	143.20		143.20
New Mexico.....	114.75		114.75
Arizona.....	10.00		10.00
South Dakota.....	1.00		1.00
Total.....	5,979.22	106	6,085.22

RANGE.

An exceptionally heavy burden has been placed on the National Forest ranges by the war. The needs of the country made imperative the most aggressive action possible for facilitating and stimulating the production of meats, hides, and wool. Provision for more live stock on the ranges has been along two lines. Use of new areas has been brought about, and larger numbers of stock have been admitted to the ranges already in use.

Both courses of action necessitated skillful range administration. The demand for grazing privileges for years has been in most localities far beyond the carrying capacity of the Forests. Unused range was to be found only where it was very difficult to reach, unusable for lack of water, or overlooked because under the customary methods of handling stock the animals passed it by—the nooks and corners, as it were, of ranges supposedly already occupied to their full normal capacity. On the other hand, emergency increases through allowing heavier use of the areas already carrying stock involved the risk of overgrazing. To meet the situation the best grazing experts in the Service were taken from their usual work and organized as an inspecting force, charged with the twofold duty of locating all unused portions of the range and devising methods for making it available, and of observing closely the conditions of the ranges already occupied to determine up to what limit it might be possible to make temporary increases without serious impairment of productive capacity. Plans were pressed forward for opening up inaccessible ranges and securing the development of water on dry ranges, and every effort was made to insure the best distribution of the stock so that none of the forage crop might be wasted. Wherever the condition of the range permitted, the grazing authorizations were raised and the effect carefully studied. The result was to increase the number of animals permitted to graze on the National Forests by about 1,063,000.

Both range and market conditions were exceptional throughout the fiscal year 1918. The summer and fall season of 1917 was dry. Feed everywhere was short; yet live stock of all kinds came from

the National Forests in first-class condition. Never were lambs and sheep fatter or more fully ready for market. Steers weighed well, and the prices offered for all meat animals were high. The one drawback, and it was a serious one, was the shortage of stock cars to carry the animals to market.

The sheep men fared fairly well, as their product was marketed early, before the shortage became acute; but thousands of beef animals fresh from the Forest ranges and fit for the block were held for weeks at shipping points where hay was not only high but decidedly scarce. Numbers of them fell off so seriously in condition as to be fit only for feeders when cars were finally secured. Thousands were returned to the winter ranges to be held over for another season.

Officers of the Forest Service and other bureaus of the Department of Agriculture cooperated heartily with the Food Administration in efforts to secure cars and improve the situation.

At the close of the grazing season of 1917 the outlook for winter was extremely unsatisfactory. Grass and forage of all kinds were short. The hay production for the summer of 1917 was below normal, prices of all kinds of feed were high and constantly advancing, and stock men were generally inclined to sell down as closely as they could, rather than attempt to winter stock under such prospects. The winter, however, was surprisingly favorable. Snowfall was not excessive, but general enough to admit of using desert winter ranges to the fullest extent; there were no heavy storms or long periods of low temperature; only very moderate hay feeding was necessary, and live stock of all kinds came through the winter in excellent condition.

In general throughout the western range country the spring and early summer of 1918 were highly unfavorable to stock on the open ranges adjoining the National Forests. On practically all the Forests, however, the feed was about normal.

The returns from live stock sold, especially lambs, were unusually high. For the shipping season of 1917 the average weight of over 22,000 Forest lambs from the Madison Forest, in Montana, with a 12-hour shrink before weighing, was 74.4 pounds. This was 6 pounds less than the average for 1916, which was a record season. A shipment of 1,000 lambs from this Forest averaged 90½ pounds and sold at 15½ cents at loading point, netting \$14.02 each. Another shipment of 2,341 lambs averaged 80¼ pounds, and brought 15 cents at loading point, netting \$12.03 each. A 4-year-old steer in a shipment from the Custer Forest, in Montana, brought its owner \$225.70 on the Chicago stockyards. Twenty yearling steers from the Medicine Bow Forest, in Wyoming, weighed an average of 590 pounds on the St. Joseph yards, and sold for \$9.40 per hundred, bringing an average of \$55.46 each.

During the season of 1917, in round numbers, 59,000 head of cattle and 350,000 head of sheep, not counting lambs, used the ranges of the Humboldt Forest, in Nevada. From these herds and flocks the stockmen sold a total of 11,000 steers and 285,000 lambs. It is estimated that the average gain in weight of each steer while on the range was fully 200 pounds and of each lamb 25 pounds. On a basis of 7½

cents per pound for each steer sold and 10 cents per pound for each lamb this gain was worth over \$1,162,500. The total grazing fees paid amounted to \$52,258, which includes also grazing fees on the cows, ewes, and younger animals not sold. The actual gain in meat alone was over twelve million pounds, not considering the wool growth.

On the Ashley Forest, in Utah, the owners of a large number of cattle of all ages estimated that the animals gained an average of 300 pounds each during the period in which they used the Forest range. The grazing fee was 31 cents per head.

The carrying capacity of some of the Forests is very large. For the season of 1918 the Humboldt in Nevada, with 58,853 cattle and over 350,000 sheep, heads the list. The Sawtooth in Idaho carries over 300,000 sheep, the Caribou in the same State over 281,000, and the Rio Grande in Colorado 284,000. The Tonto Forest in Arizona furnishes grass for over 70,000 cattle and the Prescott in the same State finds room for over 61,000, with more than 68,000 sheep to keep them company. The capacity of the Arizona Forests is the more remarkable in that they are yearlong ranges, the cattle remaining upon them throughout the year.

Ten years ago the number of wild, unclaimed horses on many of the Forests constituted a menace to the other and more valuable stock, especially cattle. Horses are more injurious to ranges than any other class of live stock because of their manner of traveling on the ranges and the fact that they graze much closer than cattle, or even sheep. For a time the demand for a certain class of light horses resulted in the gathering and shipment of a large number of these animals. In recent years, however, this demand has almost ceased, their numbers have increased, and they are again becoming a pest on certain well-stocked Forests. Where water is scarce they drink from tanks and reservoirs badly needed by the cattle, while they make heavy inroads upon salt, fighting cattle away from the salt troughs and often injuring the calves and weaker cattle in their mad rushes from the salt grounds on the approach of mounted men. Many of these bands of horses are unbranded and have no actual owners, although "maverickers" operate among them constantly, thus keeping the animals on the move, disturbing the cattle, and injuring the range. Many are so wild as to make it difficult to round them up, except at heavy and almost prohibitive costs.

The ranges used by these range outlaws is badly needed for the use of cattle, whose value is far beyond that of the horses; and on several Forests it has been deemed advisable to refuse to issue further permits for grazing this class of stock, thus compelling the owners to remove from the Forest ranges those that can be gathered. By this means it is hoped gradually to reduce the number of wild horses very decidedly, and through the organization of special roundup parties, with the sole object of gathering and shipping the wild ones out of the country, they will ultimately all be moved and the range saved for the use of stock of higher economic value.

In several parts of the Southwest, notably in some of the Arizona Forests and in the Grand Canyon National Monument, the increase of wild burros is a serious problem on the ranges. These animals are

owned by nobody and are even more difficult to capture and handle than the wild horses.

The shipment of sheep to and from the Forest ranges is now becoming more and more frequent. This has been forced upon sheep owners, owing to the rapid settlement of the open ranges adjoining the Forests and across which they have been heretofore accustomed to drive to and from the Forests in the spring and fall. From the standpoint of conditions within the Forests, shipping is very desirable. Upon many of the driveways established across Forest ranges for stock in transit the pressure has become so heavy as to make it absolutely necessary to cut down very materially the number of stock using them; for the driveways were fast becoming denuded of all vegetation and the sheep found little feed on them while crossing. In the final analysis it is believed shipping will be cheaper than trailing, taking into consideration all the losses and difficulties encountered in moving stock over driveways, some of them more than 150 miles in length.

Advances in the methods of range utilization and stock management on the Forests are being made along many lines. Continued success in the eradication of poisonous plants is reducing the losses of live stock from this cause. Many forward steps are made possible by the organization of range users in associations with which the Forest Service can cooperate for the introduction of improved methods with which all the users of a given range must comply.

Thus, on several ranges the permittees have agreed through their advisory boards, representing the local associations, to keep the yearling heifers separate from the other stock on a special range, so that they will not be bred until they are of suitable age. On a number of Forests the associations are maintaining special bull pastures in which the bulls are held until wanted on the ranges. On other ranges, where steers are numerous and interfere with calf production, separate ranges are set aside for steers only and all permittees grazing steers above 1 year old must hold them on this especial range. Usually this is done through a regular hired herder.

Open range branding, that long-standing source of loss and injury to the cattle and friction among the permittees, has been stopped on many Forests through the adoption of a special rule prohibiting the branding or rounding up of the cattle except at certain definite times or in the owners' own home corrals. Then all the interested stockmen are on hand, the range is worked systematically, and the calves are branded up, after which the stock is allowed to remain undisturbed for the rest of the season instead of being constantly milled and chased about by men who are more often looking for mavericks than for their own stock.

All of these things mean better returns to the permittees from their investments, decreased cost of handling, increased calf production, a reduction in losses of many kinds, and an improvement in the general forage conditions over the ranges, together with more harmonious relations among the permittees. Such methods can not be worked out on the open public domain, and this fact adds to the value of the grazing privileges on the National Forests.

Grazing permits issued and number of stock grazed under permit, fiscal year ended June 30, 1918.

State.	Cattle, horses, and swine.				Sheep and goats.		
	Per- mits issued.	Number of stock grazed.			Per- mits issued.	Number of stock grazed.	
		Cattle.	Horses.	Swine.		Sheep.	Goats.
Alabama.....	7	89					
Arizona.....	1,518	334,063	6,773	1,075	159	427,873	5,580
Arkansas.....	74	1,363	8	83	1	34	
California.....	3,142	214,312	8,410	1,076	464	570,722	11,233
Colorado.....	4,513	400,883	10,553		846	1,105,071	1,332
Florida.....	20	118		42	2	654	
Georgia.....	46	168	73	45	1	10	
Idaho.....	4,185	189,581	14,452		1,100	1,960,161	
Michigan.....	1	14			3	78	
Minnesota.....	1	53					
Montana.....	2,926	175,200	17,908		480	809,855	500
Nebraska.....	57	13,770	872				
Nevada.....	518	83,909	5,776		123	467,473	
New Hampshire.....	10	99					
New Mexico.....	2,238	186,640	6,291	640	653	483,501	39,007
North Carolina.....	174	898	51	84	8	89	
Oklahoma.....	73	4,322	255				
Oregon.....	2,492	156,583	10,380	10	551	783,473	181
South Dakota.....	743	31,639	3,754		1	1,500	
Tennessee.....	46	297	4		6	33	
Utah.....	7,397	178,851	10,681	316	1,607	842,327	115
Virginia.....	267	2,448	49		6	53	
Washington.....	948	29,306	1,761		174	222,272	
West Virginia.....	1	14					
Wyoming.....	1,203	133,234	4,105		328	779,056	
Total, 1918.....	32,600	2,137,854	102,156	3,371	6,513	8,454,240	57,968
Total, 1917.....	31,136	1,953,198	98,880	2,306	5,502	7,586,034	49,939

WATER POWER.

The receipts from water power permits were \$93,976.35, as against \$106,389.48 in 1917. Ten applications for preliminary rental permits were received, 31 for final rental permits (of which 28 were for permits for transmission lines only), and 14 for free permits, of which 1 was for a transmission line only. At the close of the year 16 preliminary rental permits, 228 final rental permits, and 107 free permits were in force for power projects involving the use of National Forest lands for reservoirs, conduits, or power houses, with or without transmission lines, while 142 final rental permits and 13 free permits were in force for transmission lines only, of an aggregate length on National Forest land of 838.8 miles.

The extent to which power development has actually taken place on the National Forests is best evidenced by the figures for the estimated average output at minimum discharge of the projects having reservoirs, conduits, or power houses on Forest lands. For all permits in force at the close of the year this was 776,709 horsepower, as against 738,450 at the close of the previous year. Of this, 405,368 horsepower, as against 365,208 one year previously, is credited to projects for which all construction is complete; 157,502 horsepower to incomplete projects; and the remainder to projects on which construction has not yet started.

The war has had a marked effect upon the electric-power industry. The demand for power is increasing rapidly. It is most acute in the

manufacturing centers of the Eastern and Central States and on the Pacific coast. The surplus capacity which existed on the Pacific coast prior to the war has been absorbed, and it has been necessary in many instances to meet additional demands by steam power. Conditions are rendered still more acute by a serious shortage in petroleum, the fuel upon which steam plants in this territory are very largely dependent. Under these conditions the extension of water-power development would seem natural.

The financing of new plants or of enlargements of established plants, however, is made difficult by the general financial and industrial situation. In so far as the use of National Forest lands or of the public domain is concerned, the uncertainty regarding legislation is a further and a severe handicap. With the enactment of a law putting an end to this element of uncertainty which has so long exerted a paralyzing influence in power matters, there may reasonably be expected enough new construction to provide for essential war needs. After the close of the war conditions unquestionably will be favorable to rapid and extensive development of National Forest hydro-electric power sites. The enactment of sound legislation that will remove the present uncertainties is greatly to be desired, from the standpoint of the interest of the public in having the water-power resources employed to best advantage.

GAME.

The National Forests, with the National Parks, represent the natural and permanent home of the remaining game in the States in which these public properties are located. With the advance of settlement and intensification of industrial development, wild life is rapidly forced back to the more remote forest regions. Until recently little attention was given to the problem of wild-life conservation. It was believed that in some way nature would provide for the perpetuation of the game. At the most it was thought that game laws governing the season of hunting and a limit on each hunter were sufficient. The wild life, however, rapidly diminished, and disappeared from many regions where it formerly abounded.

It is now clear that definite provision must be made for an intelligent and constructive administration of wild life based on the establishment of adequate breeding areas, winter feeding grounds, intelligently applied laws and regulations governing hunting, etc. In short, there is needed efficient game administration in contrast to mere protection. Laws alone, without such administration, will not automatically meet the situation.

Considerable progress has already been made in this direction on the National Forests. There are three National game preserves—the Grand Canyon game preserve, with its 6,000 to 8,000 deer and other game; the Wichita game preserve, with its buffalo herd of 100 head, its elk, antelope, deer, and smaller game; and the Pisgah game preserve in North Carolina, with an abundance of deer, wild turkey, and wild fowl. In addition, there are more than 40 State game preserves within the National Forests which constitute excellent breeding grounds for various kinds of game. There is much game elsewhere in the National Forests.

Special mention may be made of the 40,000 elk in the Yellowstone region, of which about one half are in the Forests surrounding the Park, and a portion of the remainder occupy at times National Forest land; of the 3,000 to 4,000 Roosevelt elk in the Olympic Forest; of the smaller elk herds in the Forests of central and western Montana and central Idaho; and of the new herds being built up in various Forests of Colorado, New Mexico, and Arizona. Mountain sheep and goats are found in the higher reaches of the National Forests in the Cascades, Sierras, and Rocky Mountains. Bear, black-tail and white-tail deer, moose, and fur-bearing animals are still abundant at many points.

Improved public sentiment, better game laws, and more active State game commissions, as well as the vigorous work of the Forest Service, have checked the diminution of wild life within the National Forests. At many points the tide has turned and increases are taking place. But the problem is by no means solved. If the National Forests were to remain a wilderness, mere protective measures would suffice. The Forests, however, will be increasingly utilized. Development of the resources will build up communities, and many more people will be occupied in the Forests in various activities. The right handling of certain classes of game is very dependent on the way the grazing of domestic stock is managed. This applies particularly to such game as elk, antelope, and black-tail deer, which are essentially grazing animals.

To provide for these conditions the Forest Service is developing specific plans of game administration for each Forest. Where game preserves are desirable the States will be asked to establish them. Winter ranges will be provided for herds of elk and other animals of appropriate size. Recommendations for legislation by the States and the Federal Government will be made to permit of the right administration of the wild-life resource, new plants of animals will be made where new herds should be built up, and the local officers will continue to aid in the enforcement of the game laws to the extent of their ability.

A new regulation has been promulgated prohibiting entering the National Forests with the intent to kill game in violation of State laws. It will bring cases of such violation into the Federal courts, and will thus supplement and strengthen the present procedure for game law enforcement.

ROADS, TRAILS, AND OTHER IMPROVEMENTS.

At the beginning of the fiscal year there was available for road and trail construction in the National Forests \$2,399,179.11, derived as follows:

Agricultural appropriation for the construction and maintenance of permanent improvements -----	\$400, 000. 00
10 per cent appropriation for the fiscal year -----	339, 549. 61
Unexpended balance of 10 per cent appropriation for preceding years -----	138, 386. 16
Appropriation for the fiscal year under section 8 of the Federal aid road act -----	1, 000, 000. 00
Balance of section 8 appropriation for preceding years -----	971, 243. 34

At the end of the fiscal year there was an unexpended balance in the 10 per cent appropriation of \$302,811.39, showing a total ex-

penditure for the year of \$175,124.38. There was also an unexpended balance in the section 8 appropriation of \$1,803,837.37, showing an expenditure during the year of \$167,405.97.

The following tabulation gives the number of miles of public roads constructed prior to December 31, 1917, from the 10 per cent, section 8, and cooperative funds:

Road construction and improvement,¹ from the 10 per cent, section 8, and cooperative funds, by States.

State.	Total mileage to Dec. 31, 1917.	Total mileage in calendar year 1917.		State.	Total mileage to Dec. 31, 1917.	Total mileage in calendar year 1917.	
		10 per cent fund.	Section 8 fund.			10 per cent fund.	Section 8 fund.
	<i>Miles.</i>	<i>Miles.</i>	<i>Miles.</i>		<i>Miles.</i>	<i>Miles.</i>	<i>Miles.</i>
Alaska.....	21.21	10.50	.....	Nebraska.....	4.60	.....	.....
Arizona.....	127.70	7.45	.....	Nevada.....	136.35	.....	4.00
Arkansas.....	24.50	5.25	.....	New Mexico.....	71.60	3.35	.....
California.....	257.88	22.50	1.40	Oklahoma.....	28.00	10.50	.....
Colorado.....	172.67	63.97	.....	Oregon.....	175.61	27.10	.10
Florida.....	10.00	.....	.....	South Dakota.....	14.05	.95	.....
Idaho.....	176.89	47.43	.....	Utah.....	143.35	.....	1.50
Kansas.....	3.40	.....	.....	Washington.....	82.63	2.07	.....
Michigan.....	22.20	.....	.....	Wyoming.....	76.10	1.95	.....
Minnesota.....	2.00	.....	.....		
Montana.....	192.25	11.50	.....	Total.....	1,742.99	² 214.52	7.00

¹ Does not include bridge or maintenance work.

² Road construction, 81.19 miles; repairs, 121.26 miles; trail construction, 12.07 miles.

While the total mileage constructed or repaired in the calendar year 1917 was about 74 miles greater than in the preceding year, it will be noted that very little work was done on section 8 projects, which are of a relatively high type of construction, and that only about 81 miles of road were constructed, in whole or in part, from the 10 per cent appropriation. It was stated in last year's report that little construction work could be anticipated. Difficulties in obtaining the necessary labor and materials were foreseen, but the allowances made for the effect of the war on road work were insufficient. The small amount of construction work done during the calendar year 1917 was due to some extent also to the delays involved in negotiating cooperative agreements, to the necessity for making location surveys and plans on section 8 projects, and to difficulties encountered in effecting a satisfactory organization.

In the spring of 1918 a considerable number of projects were ready for construction. While it was realized that the supply of available labor had been greatly reduced by enlistments and the draft and by the large enrollment in shipbuilding and other war industries, and while it was known that the cost of work would be very high, the full extent of the effect of the war on the road work was not revealed until attempts were made to let work by contract. Few contractors were willing to bid at all; and those making bids, in attempting to forecast the cost of doing work, submitted proposals greatly in excess of the engineer's estimates and the total amounts made available by the cooperators.

Supplementary agreements were found necessary in nearly all cases. In several instances the purpose of the supplementary agreement was to give the department control over the starting and stopping of construction work so as to avoid any possibility of interfering with the prosecution of the war. The remaining agreements were occasioned by the increased cost of the work. In some cases changes in the terms of the original agreements were made so as to lessen the amount of work to be done by reducing the standard of construction or the length of the project. In other cases, an increase was made either in the percentage of Federal cooperation or in the amounts which the cooperators agreed to expend. Naturally, considerable time was lost in negotiating these supplementary agreements and in endeavoring to let work by contract. In a large number of cases, therefore, the construction season was well advanced before contracts were let or the decision made that work must either be done by day labor or be indefinitely postponed.

The administrative action during the fiscal year on projects approved under section 8 of the Federal aid road act is indicated in the following tabulation:

Federal aid road act projects.

Type of work.	Number of projects.	Number of agreements.			Mileage.	Liability.		
		Original.	Supplementary.	Total.		Government.	Local authority.	Total.
Survey.....	8	8	.....	8	247.70	\$23,622	\$23,778	\$47,400
Survey and construction.....	1	1	.....	1	45.00	270,000	40,000	310,000
Survey, construction, and maintenance.....	29	25	12	37	553.85	933,782	1,220,338	2,154,120
Maintenance.....	1	1	.....	1	45.00	.....	.....	.....
Totals (duplications eliminated).....	38	34	12	46	846.55	1,227,404	1,284,116	2,511,520
Projects placed under original agreement during preceding fiscal year....	4	.....	4	4	118.65	187,975	283,975	471,950
Totals for projects placed under agreement during fiscal year 1918 (duplications eliminated)	34	31	8	42	727.90	1,039,429	1,000,141	2,039,570

At the end of the fiscal year 43 projects were under cooperative agreement, involving the survey of 1,061.85 miles and the construction of 664.15 miles. The estimated cost of this work is \$2,779,620, of which the Government's share is \$1,347,554. In addition to the above, five projects involving the use of the 10 per cent fund were under formal cooperative agreement. These covered the survey of 43.84 miles and the construction of 54.56 miles at an estimated total cost of \$152,550, of which the Federal share is \$84,509. While a considerable percentage of cooperation is obtained in the 10 per cent work, the greater part of the projects are not covered by written agreements.

In selecting the projects for work during the calendar year 1918, great care was exercised to eliminate all which would tend to interfere with the prosecution of the war. The construction of several

projects which under ordinary conditions would have been of first importance was definitely shelved until after the war. As a result, the number of projects approved for work this year is comparatively small, and the anticipated expenditures considerably below the appropriations.

Comparatively few National Forest road projects can qualify for approval under the policy adopted by the United States Highways Council. A few projects, such as the Hornbrook-Seiad road in California, will prove to be of national economic importance through giving access to or promoting the output of necessary materials. Aside from projects of this class and certain others where the improvement of comparatively short sections is needed in order that work already done may be made available for the use of local communities, it seems probable that work on National Forest roads during the war will be confined largely to maintenance and repair, and to the construction and improvement of roads necessary to the protection of public property or to the relief of acute local needs. For this reason it is anticipated that a greater mileage of road will be maintained and a larger amount of money spent on maintenance and repair work than in any preceding year. This work will be paid for almost entirely from the 10 per cent appropriation. With the exception of investigative and survey work, the section 8 work will be largely at a standstill, and the money will be allowed to accumulate in the Treasury until the end of the war.

Amounts available for roads and trails from fiscal year 1919 funds.

State.	10 per cent item.	Section 8 Federal aid road act.	State.	10 per cent item.	Section 8 Federal aid road act.
Alaska.....	\$9,656.78	\$47,061	Alabama.....	\$12.99	\$25,665
Arizona.....	37,034.52	54,318	Georgia.....	172.50	
Arkansas.....	3,796.54	9,875	Maine.....	114.83	
California.....	43,441.35	141,558	New Hampshire.....	1,267.85	
Colorado.....	35,641.53	63,932	North Carolina.....	629.83	
Idaho.....	42,870.98	104,700	South Carolina.....	38.65	
Montana.....	30,639.02	71,664	Tennessee.....	489.78	
Nevada.....	8,670.22	19,228	Virginia.....	2,292.29	
New Mexico.....	27,428.86	37,811	West Virginia.....	294.21	
Oregon.....	38,074.87	132,796	Special fund.....		100,000
South Dakota.....	6,120.36	7,992			
Utah.....	22,922.70	39,370			
Washington.....	16,982.96	92,565			
Wyoming.....	16,238.25	41,510			
Florida.....	924.38	9,955	Total.....	350,533.74	1,000,000
Michigan.....	36.11				
Minnesota.....	3,214.08				
Nebraska.....	923.46				
Oklahoma.....	603.84				

In consequence of the strain put on the Forest force by its depletion through war demands and by the bad fire season, the usual reports covering various classes of work were not called for at the close of the fiscal year, which falls at the busiest period. It is therefore impossible to include in this report the usual details regarding the construction of improvements of various kinds. The general policy now governing all work of this character is to make no demands upon the country's supplies of labor and materials which can be avoided without detriment to the national effort for bringing the war to a successful issue and for reasonable readiness to meet post-war conditions.

COOPERATION WITH STATES.

Expenditures from the appropriation of \$100,000 made by Congress for fire protection on the forested watersheds of navigable streams in cooperation with the States, and the expenditures of the States which have entered into cooperative agreements for this purpose, are shown in the following table:

Cooperative expenditures from Federal appropriation and by the States for protecting forested watersheds of navigable streams from fire.

State.	Expenditure fiscal year 1918.			State.	Expenditure fiscal year 1918.		
	Federal.	State.	Total.		Federal.	State.	Total.
Maine.....	\$9,382.08	\$98,305.27	\$107,687.35	Wisconsin.....	\$3,503.07	\$16,094.32	\$19,597.39
New Hampshire....	6,899.85	26,563.97	33,463.82	Minnesota.....	9,090.96	47,341.80	56,432.76
Vermont.....	1,296.25	2,046.31	3,342.56	South Dakota.....	197.00	1,917.07	2,114.07
Massachusetts.....	3,417.34	31,187.79	34,605.13	Montana.....	3,385.23	13,493.34	16,878.57
Connecticut.....	950.75	7,380.86	8,331.61	Idaho.....	7,712.84	45,360.17	53,073.01
New York.....	5,299.29	97,885.83	103,185.15	Washington.....	9,770.00	38,929.46	48,699.46
New Jersey.....	2,105.85	23,841.75	25,947.60	Oregon.....	7,955.75	27,450.94	35,446.69
Maryland.....	1,631.50	3,769.68	5,401.18	Administration and inspection...	8,081.19		8,081.19
Virginia.....	3,472.50	3,557.33	7,029.83	Total.....	99,952.14	573,761.98	673,714.12
West Virginia.....	5,455.50	7,129.16	12,584.66	Unexpended bal- ance.....	47.83		
North Carolina.....	1,121.66	1,331.95	2,453.61	Appropriation	100,000.00		
Kentucky.....	1,669.36	7,067.27	8,736.63				
Louisiana.....	183.17	1,824.47	2,007.64				
Texas.....	3,781.00	5,184.96	8,970.96				
Michigan.....	3,555.00	66,098.25	69,653.25				

Louisiana requested cooperation, and an agreement was entered into toward the end of the fiscal year. This State makes the twenty-second to receive cooperation of this character.

The Federal fund was used almost exclusively for the hire of Federal patrolmen and lookout watchmen, who form an integral part of the State protective systems. The maximum regular allotment to any State for patrol purposes was fixed at \$8,000, and additional smaller allotments were made from time to time to encourage the extension of patrol work, the construction of protective improvements, the preparation of forest-fire plans, and the like. It was necessary in a number of cases to make further allotments for increasing the salaries of the Federal men in order to hold the protective force intact. An adequate inspection of the cooperation in each State every year has shown that it is being well conducted, and has also afforded a means of keeping in close touch with the activities of the States in forest-fire protection.

On the basis of forest-fire statistics collected through State and private agencies in over 40 States, it is estimated that approximately 28,000 fires occurred throughout the country, which burned over an area of about 12,000,000 acres and caused a loss in timber, young-tree growth, and improvements of about \$9,000,000.

The States of Arkansas, Georgia, Illinois, Louisiana, Mississippi, North Carolina, and Texas received assistance during the year in formulating forest policies, drafting forestry laws, and the like. Compilations of the forestry laws of Colorado, West Virginia, and New York were prepared.

WAR RESEARCH WORK.

Wood products are among the most important materials of the war. Lumber is required in immense quantities for the extension of

military posts, for the construction of buildings in connection with the new training camps, for ship building, for industrial housing, etc. The war has also brought an unusual demand for special wood products such as material for artillery carriages, escort wagons, and other vehicles, rifle stocks, airplanes, shipping containers, and various military materials and equipment requiring the use of by-products.

Critical problems have arisen relating to wood supplies, technical qualities of woods heretofore little used, drying processes, the development of waterproof glue, the design and construction of laminated structures and plywood, the manufacture of by-products of wood, and many other matters. The research work in forestry and forest products conducted by the Forest Service in past years has supplied a large part of the information needed by the military branches. The need for special war materials, however, has called for a great deal of information which in ordinary times would not have been needed for some years and which would have been gathered in the normal process of the research work. To secure this special information speedily, practically the entire research organization of the Forest Service has been placed on special war investigations and the organization has been increased in size more than five times to meet the situation. Information has been required by practically all the war-work branches of the Government having to do with the purchase of wood materials. These include in the Army the General Staff, the Bureau of Aircraft Production, the Ordnance Department, the Signal Corps, the Quartermaster Department, the Engineer Corps, the Gas Warfare Service, and the Surgeon General's Office; in the Navy the Bureaus of Construction and Repair, Steam Engineering, Yards and Docks, and the Navy Yards; the Shipping Board; the Emergency Fleet Corporation; the Director General of Railroads; the War Industries Board; the War Trade Board; housing organizations; the Fuel Administration; and the Food Administration. In addition, there has been cooperation and assistance to the allied Governments and to the industries furnishing war materials.

LABORATORY INVESTIGATIONS.

Among the most urgent problems requiring immediate extensive research were those connected with the construction of aircraft. One of the most exacting uses to which wood has ever been put is in the framework of airplanes and airplane propellers. In order to secure satisfactory material, the methods of selection, treatment, and use must be based on test data in the same way as is done with other structural materials like iron, steel, and cement. The Forest Products Laboratory had a large amount of data on the properties of airplane woods at the beginning of the war. Much more was needed, however, and since the war aircraft problems have occupied the attention of about two-thirds of the force at the Madison laboratory.

Information on the properties of various woods has been required by the Bureaus of Aircraft Production and of Construction and Repair in preparing specifications so as to avoid the use of material lacking in certain needed properties, such as shock-resisting ability, strength, stiffness, hardness, etc.

Spruce has been the standard wood for the wing beams in airplanes, upon which the strength of the wing depends, and for the

interplane struts between the wings. Sitka spruce from the west coast and red and white spruce from the east are all satisfactory airplane woods when properly selected and dried. Not only must checks and knots be avoided, but the direction of the grain must be carefully examined. Only a slight deviation from straight grain can be allowed.

At the beginning of the war it was customary to air-dry all wood used in airplane construction, on account of the danger of injuring the strength by methods employed in commercial kiln-drying. As it takes about two years to air-dry spruce in airplane sizes, and quantities of material were needed at once, kiln-drying was absolutely necessary. Investigations in kiln-drying had been under way at the Madison laboratory for several years, and methods had been worked out for a number of woods. An extension of these investigations to include spruce showed that it could be kiln-dried without loss of strength in less than a month. This information was used as a basis for preparing specifications for drying airplane stock. Numerous dry-kilns designed on the principles of experimental kilns at Madison, so as to allow the regulation of temperature, humidity, and amount of air passing over the wood to be dried, have been built by companies with airplane contracts. A large battery of kilns designed by the Forest Service has been erected by the Government at the cut-up plant of the Bureau of Aircraft Production at Vancouver, Wash.

The necessity for high-grade material in airplanes in order to keep down the size and weight of parts makes only a small proportion (from 10 to 20 per cent) of the lumber cut at the mill available. The high quality of material needed, together with the difficulties attendant on getting large spruce production and the increasing demands of the Allies, have necessitated the use of other species. The results of the extensive earlier investigations at Madison, supplemented by special tests, have made this possible. Port Orford cedar, Douglas fir, and other woods are now allowed for airplane construction, and a serious situation in the shortage of material is being relieved.

The test data which have been secured cover the relative suitability of many possible substitutes for spruce. These will make possible not only the selection of the best species to meet the maximum requirements which may be developed by the war but also (what is equally important) avoidance of the use of unsuitable species.

The work of past years has shown that practically no two woods should be kiln-dried under the same conditions of temperature, humidity, and circulation. It has been necessary, therefore, to develop safe methods of artificial kiln-drying for the best spruce substitutes.

A problem has also been encountered in finding how to select and treat wood for airplane propellers so that the finished propeller will give satisfactory results. Propellers are built up of several laminations glued together and then cut to shape. Much trouble has been due to the joints failing or the blades warping on account of unequal shrinkage or swelling in the adjacent laminations. Data covering density and moisture in laminations are being obtained with a view to reducing the percentage of failures.

Heretofore most propellers have been made of black walnut or mahogany. The heavy demand on these woods has made a search for substitutes necessary. Studies to find satisfactory substitutes are

being made. Tests also are being carried on to aid in the perfecting of designs for propellers. A waterproof coating has been found which practically eliminates absorption of moisture in the completed propeller, and hence shrinking and swelling, which are the cause of much propeller trouble.

Extensive experiments are being made in connection with the use of laminated construction in parts of airplanes. The production of material would be enormously facilitated if it were not necessary to rely on single pieces in constructing the wing beams of the planes, for these beams can be secured only from the most perfect wood. Various built-up beams and struts have been tested at the Madison laboratory, and a number of designs have been found satisfactory and used in airplanes. Methods are also being perfected for the most effective designs for various splices and joints, permitting the use of small-sized material, which can be produced in large quantities.

The use of laminated structures and veneers in airplanes requires waterproof glue, an expert treatment of the wood, and a very careful application of the glue in manufacturing the material. Waterproof glues have been developed and demonstrated to manufacturers, and the experiments have resulted in the drawing of specifications for the whole process of manufacturing laminated structures and veneers. Standard methods of tests have also been developed and a system of inspection and certification perfected to insure the acceptance of satisfactory glues only.

Plywood formed by gluing together several sheets of veneer will be increasingly used for various parts of airplanes. It can be formed or molded to the proper contour of the body or wing, and its possibilities as a substitute for linen, which has been generally used for body and wing covering, are striking. Little information has existed as to the properties of veneer and plywood as a structural material. Its greatest uses have been for industrial purposes, where an exact knowledge of its strength and stiffness was less necessary. A plywood wing rib, which supports the wing cover, has been developed for one type of plane as a result of the veneer investigations and has been adopted for standard production. The weight of this rib is nearly one-third less than that of the standard design, but its strength is 200 per cent greater. The significance of this may be realized when the importance of weight and strength in airplane design is considered. The results of these tests are indicative of what may be done for other similar airplane parts.

The military branches have encountered a problem of great magnitude in connection with containers and crates for over-seas shipments. There has been involved in the first place the question of suitable species of wood for containers and crates, and, second, of the designs which have the required strength and at the same time occupy a minimum shipping space. The necessary investigations have been conducted in cooperation with the Division of Purchase and Supplies of the General Staff and the Ordnance Department. The result has been the improvement of specifications for containers and crates, and the use of many more species with a consequent very large saving of cost to the Government and of shipping space, and with a great reduction in loss by breakage. The results of former work on shipping containers, conducted in cooperation with the Bureau of Explosives and the Association of Box Manufacturers, have been of di-

rect application in aiding the present war program. New problems are constantly presenting themselves.

The question of rapidly drying gunstocks has been a matter of prime importance. The work already done along this line in cooperation with large arms companies was of great help in furnishing companies with gunstock contracts with necessary data to cut their losses to a minimum. The possibility of using laminated gunstocks in place of the standard one-piece stock has been under investigation. Such gunstocks would make usable much smaller pieces and a considerably larger portion of the black walnut cut.

Under ordinary commercial practice oak and other vehicle stock has been air-dried, requiring a period of from two to three years. The greatly increasing demands of the war for dry material have rapidly depleted surplus stocks of dry material, which are now approaching the point of exhaustion. Tests have shown that oak under proper methods can be dried with a much smaller percentage of loss in kilns than in the open air, and the period of drying reduced from two or three years to two or three months. The investigations have been placed at the disposal of a great number of manufacturers of war orders. The assistance given these manufacturers has included the design of a large number of kilns, with a consequent vastly enlarged kiln capacity, and the improvement of drying methods.

On account of the shortage of tin the use of fiber containers made from wood pulp has been considered for many new purposes. Investigations made in cooperation with the Ordnance Department and the Food Administration have yielded results of definite practical usefulness in the packing of ammunition.

The Forest Service has been called upon also for investigations in connection with wood-distillation products for various military uses.

The laboratory is cooperating in the training of men to act as box experts in the various offices of the War Department, as box inspectors at ports of embarkation and manufacturing plants, and as box makers. A considerable number of kiln operators and inspectors, glue experts and inspectors, and in general experts and inspectors on wood for practically all of its numerous uses in modern warfare are being trained for the Army and for private manufacturers.

A large part of the work done along all lines has already had direct application in specifications for raw and final wood products, in design, in technical processes of manufacture, and, in fact, in almost every phase of selection, purchase, and utilization. The services of members of the Forest Service are in constant demand for advice and assistance of this character in both the Army and the Navy.

FOREST INVESTIGATIONS.

From early in the war urgent demands have been made upon the Forest Service for information regarding various kinds of timber which were not being produced in sufficient quantities, such as spruce, black walnut, bark and acid wood for tanning, and wood fuel. Information was also needed on species which were in danger of running short of grades particularly necessary for specific war purposes. Among the woods of this group are chiefly the eastern hardwoods—the oaks, the ashes, hickory, basswood, beech, birch, rock elm, and maple.

As substitutes for Sitka spruce the eastern red and white spruces were first investigated. A very comprehensive study was made of the available supply of eastern red spruce, which facilitated its use by the Navy for airplane construction. In addition, the supplies and grades of Port Orford cedar, western white pine, Douglas fir, incense cedar, redwood, cypress, western hemlock, the true firs (silver, noble, white and lowland), and sugar pine have been investigated. The eastern white and Norway pines and yellow poplar, which next to spruce are the most promising eastern species, were covered in considerable detail by field studies. Purchases are already being made of a number of these substitutes by the Allies and the United States.

Black walnut is of prime importance for the construction of propellers and for gunstocks. That its value was appreciated by the German Government is attested by the fact that large quantities of it were exported to that country in the years immediately preceding the war. The production of black walnut has been considerably increased since the United States entered the war and is now probably taking place at the rate of about one-fifth of the country's total stand per year. The Forest Service has been assisting the War Department in its campaign to stimulate the production of walnut for war uses. Several men have been maintained in the field since early spring looking up supplies of timber. The States Relations Service has given very valuable cooperation in the search for walnut timber. Detailed studies were made of the methods of manufacture, with a resulting increased efficiency.

The Forest Service also cooperated with the Boy Scouts in conducting an organized search for black walnut.

There might seem to be little connection between the Army's requirements for shoes and the forests, but in point of fact the immense quantity of heavy leathers required for the large order of the new Pershing shoes brought the country face to face with a serious shortage of tanning materials. Under normal business conditions the tanning industry of the United States uses about 175,000 tons annually of imported tanning materials. Owing to the scarcity of ships it was impossible for the Shipping Board to provide space for such a large amount of material. The Forest Service therefore undertook a study of the domestic tanning industry at the combined request of the Shipping Board and War Industries Board. A thorough canvass was made of the chestnut extract plants in the Southern Appalachians and of the bark producers in the North. It was found that the supply of wood on hand at the plants was only about 40 per cent of the normal supply, and that the plants were producing only about 70 per cent of their possible output. The reasons for this situation were found to be lack of woods labor and of transportation facilities, shortage of coal, shortage of labor at the plants, and delayed transportation of the finished products and the return of tank cars. Owing to the labor situation the price of acid wood in many localities has advanced from \$5.50 to \$10 per cord of 160 cubic feet. The amount of chestnut oak bark and other barks on hand was also found somewhat below normal. As a result of the investigation the War Industries Board, in cooperation with the Labor Department, the Railroad Administration, and the Fuel Administration, took remedial measures so that the extract plants could run at increased capacity.

In early times wood was almost the exclusive fuel in use, but it was long ago displaced by coal for almost all industrial purposes and for domestic use in most cities and towns. Of recent years the same thing has been taking place in many of the more prosperous farming sections, even with plentiful local supplies of wood at hand. The fuel emergency which came last winter changed this. From a matter of individual convenience, the choice and use of fuel became a national question of vital importance directly bearing on the war. It was soon found the coal was not sufficient to go around and that transportation was short even if there were enough coal. Measures were at once adopted to save coal and increase its production, but this was not enough; the lack of transportation was still to be met. It was then that the long-neglected wood fuel was thought of, as it was already distributed and formed a good reserve.

A wood-fuel campaign was opened by the Forest Service in the summer of 1917 and was carried on during the winter of 1917-18 in cooperation with the Federal Fuel Administration and various State and national agencies. Organizations were effected having in view the production and distribution of wood fuel to save coal and transportation. In the depth of winter, as the crisis became acute, great interest was aroused and action was taken by many communities.

The vital objective of the wood-fuel movement is to increase the use of wood fuel where it is possible—i. e., on the farms, in country villages, and in certain industries located convenient to wood supplies; also further to encourage the use of waste material from lumbering, from manufacture, and from dead trees and culls. The protection of permanent forest resources is not to be lost sight of in the emergency, nor are parks to be invaded and shade trees destroyed. The methods followed aim at bringing the producer and consumer together, building up reserves, and insuring a reasonable and just price. The effort for the future should be directed toward permanent fuel organizations, a systematic survey of fuel resources, adequate reserve stock, and local price regulation.

The hardwoods are playing an increasingly important part in our war program. Thus, both white and red oak are needed for airplane propellers and ship timbers. White ash, elm, hickory, hard and soft maple, yellow poplar, basswood, beech, and yellow and black birch are being sought for parts of airplane construction, veneer panels for aircraft, ammunition boxes, bent work, gunstocks, wheels, escort wagons, and many other essential war needs. Black locust is essential for treenails in shipbuilding. These hardwoods are being studied to determine the amounts of material that can be supplied by the mills, in sizes and grades needed for Government specifications, to ascertain the amounts, location, and availability of standing timber suitable for continuing the production of these grades and sizes, and to increase production by improved technical methods. Since the same species, and often the same grades, are being used for different purposes, as white oak for propellers, for shipbuilding, and for escort wagons, the study aims to adjust these different demands upon the same species and grades and attempts to eliminate the use of certain grades for needs for which some other species can be used. The points which are being sought in connection with this study of the hardwoods are quality, with reference both to present and probable future specifications of the Navy and Bureau of Aircraft Production;

accessibility; approximate total quantity and percentage of material particularly suited for propeller stock, wing beams, or any other special use; present utilization; improvements in logging or milling which will increase production; and means of utilizing new tracts.

In general a large amount of information on the most suitable woods for various purposes, together with their sources of supply, availability, and commercial value, have been furnished to the War and Navy Departments and to other cooperators.

The Forest Service has also undertaken a comprehensive study of the current production and distribution of lumber and a census of the wood requirements needed to carry out the military program. Its purpose is not only to analyze the factors which have a direct bearing on lumber production and distribution, but also to formulate a constructive policy which will aid the industry in meeting the demands made upon it. The results will be available in the form of current statistics on lumber production, shipments, and stocks on hand, supplemented by special reports on various industrial problems common to the lumber industry. Data regarding the annual production of lumber, lath, and shingles, the production of wood pulp and consumption of pulpwood, the amount of timber treated with wood preservatives, and the quantity of preservatives used were collected as in past years; and arrangements were made for collecting and compiling data on wood distillation, cooperage manufacture, and plywood manufacture. A large volume of statistical data of this character has been furnished for the use of various Government units. Figures on production and consumption in many instances have been used as a basis for reaching conclusions in problems of utilization, substitution, and regulation of imports and exports.

The requirements of the war necessitate a still further enlargement in the research organization, for which funds are urgently needed.

MISCELLANEOUS.

Thirty-four new publications were issued. The distribution of Forest Service publications totaled 370,100 copies. About 110 addresses were made, mainly at expositions and upon request from National Forest users, lumbermen's associations and similar trade bodies, technical societies, and educational institutions. Lantern slides were loaned to more than 256 persons engaged in educational work. These were shown 489 times and to 28,000 persons. Additions to the lantern slide collection totaled 1,749, and 61 bromide enlargements and 1,731 lantern slides were colored. Traveling exhibits of photographs, maps, drawings, and wood samples were loaned to 126 schools and libraries.

Additions to the Service Library in Washington totaled 804 books and pamphlets. The index of forest literature was extended by entries covering 2,652 books, periodical articles, and manuscripts. Arrangements were made for abstracting the principal articles in the forest and botanical journals, and a number of new bibliographies on special subjects were prepared, of which one on forest taxation and one relating to paper were published. Loans from the library totaled 3,220 books and 4,987 periodicals. The 166 branch field libraries now contain 31,468 books recorded in the main library, besides various State and other publications not so recorded.

REPORT OF THE CHEMIST.

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF CHEMISTRY,
Washington, D. C., October 15, 1918.

SIR: I submit herewith the report of the work of the Bureau of Chemistry for the fiscal year ended June 30, 1918.

Respectfully,

CARL L. ALSBERG, *Chief.*

Hon. D. F. HOUSTON,
Secretary of Agriculture.

The year has been one of readjustment. The urgent demands of the various war agencies, the scarcity of technically trained men, as well as the new work authorized by the Food Production Act, made it necessary to close up such projects as have no immediate bearing on the prosecution of the war as rapidly as they could be brought to such a stage that the time, the effort, and the money expended upon them would not be lost. The scientists thus liberated have been assigned to work for the various war agencies or else have been used to fill the gaps in the bureau's force engaged in the enforcement of the Food and Drugs Act. Greater vigilance than ever before has been necessary in the administration of this statute, since the general changes in the organization of the trade, as well as the scarcity or high price of many materials, have proved a great temptation to sophistication. Hence it has been necessary to make every effort to keep the bureau's regulatory force intact, though this has not been possible, even approximately. The rapidity of the turnover of the personnel is shown by the fact that on April 5, 1918, of a total force of less than 650 employees of all kinds more than 270 had been employed in the bureau for one year or less. There were in addition a great number of vacancies.

In spite of these handicaps and in spite of the very large demands upon the bureau made by the war agencies, the work of the bureau shows no great falling off. Eight hundred and one food and drug cases were sent to the Solicitor for consideration with a view to prosecution—a somewhat larger number than in the previous year. This was due in the main to the zeal of the bureau's field force. During the year the organization of this force was modified, in that the three districts were subdivided into stations, the chemists as well as the inspectors at each station being put under the direction of a single official, who in turn is responsible to the chief of the district. The results have amply demonstrated the wisdom of this plan.

Concerning the research activities during the year the bureau prepared or cooperated in the preparation of 15 Department Bulletins, 1 Farmers' Bulletin, 1 Yearbook article, and 1 circular of the

Office of the Secretary. In addition, the results of more than 60 investigations were made public and those of about 30 others are in press. The experimental work upon a number of other investigations has been completed.

The bureau has endeavored to meet, or even to anticipate, the needs of the various war agencies. Every single request for assistance has been met, so far as it has lain in the bureau's power. Indeed, more offers of assistance have been made by the bureau than the war agencies have found it possible to accept. In consequence, the war work of the bureau has been most diverse and there is hardly a war agency with which the bureau has not cooperated. Much time has been given by members of the bureau to service upon important war committees, to the furnishing or gathering of technical information requested in connection with war matters, and to acting as consultants. The technical war work of the bureau has ranged from the analysis of the garbage of the cantonments to the supervision of chemical plants manufacturing war materials. The bureau has not been intrusted with the responsibility for any one single large chemical war undertaking, but it has assisted in innumerable ways whenever opportunity presented. Many of the details of such war work are given in the following pages. Some of it is of too confidential a nature to mention.

Under the provisions of the Food Production Act of August 10, 1917, enacted by Congress for the purpose of stimulating food production during the war, the work of the bureau was shaped in the following directions: The prevention of spoilage and waste in the handling of poultry and eggs; the stimulation of the production of sea food; the stimulation of the consumption of fish and the prevention of spoilage in the transportation of fish to market; the prevention of dust explosions and fires in mills, elevators, and thrashing machines in order to conserve grain; the stimulation of the industry of dehydrating fruits, vegetables, and fish in order to conserve perishables. The details of this work will be found in the following pages, under the general headings of conservation, demonstration, and technological investigations.

During the past few years the wisdom of the legislation authorizing the bureau to "furnish * * * samples of pure sugars, naval stores, microscopical specimens, and other products" has been demonstrated. The interruption of imports created a famine in rare and unusual chemicals necessary in chemical and medical research and practice. In a number of instances the bureau has been able, acting under the authority above quoted, to assist by supplying such rare materials as certain sugars, dyes, amino-acids, and organic chemicals. The service thus rendered has not been extensive. It should, however, be extended, since there is perhaps nothing more important that a Government agency might do to assist in the establishment of a strong, self-reliant chemical industry.

ENFORCEMENT OF THE FOOD AND DRUGS ACT.

While the changes in the trade and the scarcity and high price of raw materials have tended to revive flagrant types of adulteration and misbranding that have been almost unknown for a decade, the spirit pervading the country has been such that the bureau, with its

collaborating State and municipal officials, and in some instances with the cooperation of the United States Food Administration, has been able to get results in the suppression of such abuses very much more speedily than would be possible in normal times. The interest of the Food Administration in certain of these matters has been due to the fact that practices which lead to a violation of the Food and Drugs Act also lead to waste, either in food or in basic materials, such as tin, steel, and coal, or in transportation facilities. The outstanding features, therefore, of the year's work in the enforcement of the Food and Drugs Act have been the recurrence of practices long since discarded as objectionable and more effective cooperation with other officials. To these may be added the fundamental changes in the nature of the food and drug materials offered for import because of Government control of shipping.

In two cases the courts have handed down decisions of importance in interpretation of the law. In the first of these, published in Notice of Judgment 6142, the Circuit Court of Appeals for the Seventh Circuit affirmed the judgment of conviction in the lower court against the Union Dairy Co. for a shipment of milk from Troy, Ill., to itself at St. Louis, Mo., the charge being that the milk was watered, and also filthy, putrid, and decomposed. The Union Dairy Co. contended that it was shipping the milk from a receiving station in Illinois to itself in Missouri, there to be treated, impurities removed, and the milk standardized; that while in transit it was not an article of food as defined by the Food and Drugs Act and did not become such an article of food until after treatment. The Circuit Court of Appeals held that it would be an unjustifiable construction of the act to make liability turn upon a difference in identity of consignor and consignee or the secret intent with which a shipper made the shipment; that it was also unnecessary for the court to receive evidence to establish the fact that the addition of water to milk injuriously affected the quality or strength of the milk.

In the other case, as reported in Notice of Judgment 6151, the United States Supreme Court reversed the judgment of the District Court sustaining a demurrer to the indictment alleging an article labeled in part "Compound Ess Grape" to have been adulterated and misbranded. The article did not contain any product of the grape, and the United States Supreme Court held "to call it 'compound essence of grape' certainly did not suggest a mere imitation, but on the contrary falsely indicated that it contained something derived from grapes." Mr. Justice McReynolds delivered the opinion of the court and made the comment, "The statute enjoins truth; this label exhales deceit."

DOMESTIC FOODS AND DRUGS.

Six hundred and thirty-one recommendations for criminal prosecution and 460 recommendations for seizure were made through the Office of the Solicitor to the Department of Justice. Reports of the termination in the courts of 807 cases were received by the department. Of these, 149 represent cases alleging false and fraudulent labeling of medicines or misbranding of drugs, in all of which the courts found for the Government; and 147 represent cases alleging adulteration or misbranding of stock feeds, in all of which save two the courts found for the Government. Ninety-five of the 807 cases

were reported to the United States district attorney by collaborating officials of the various States and the District of Columbia.

The accompanying table gives the distribution of the official samples examined by the various field stations. In addition thousands of shipments were examined in the field, hundreds of which involved a preliminary laboratory examination not reported in the table.

Report of field stations for year ended June 30, 1918.

Station.	Import samples.				Interstate samples.			Miscellaneous samples.	Total samples analyzed.	Hearings.	
	Legal.	Illegal.	Released without prejudice.	Floor inspection samples.	Legal.	Illegal.	Check analysis.			Personal.	By correspondence.
Central district:											
Chicago.....	268	144	9	667	239	456	120	741	1,917	204	201
Cincinnati.....	79	16	0	57	50	165	23	180	524	45	179
Minneapolis.....	35	65	5	178	94	69	3	341	612	100	83
New Orleans.....	2	59	0	379	84	140	21	547	853	80	152
St. Louis.....	41	29	0	46	2,907	1,289	14	953	5,233	179	172
Total.....	365	313	14	1,327	3,374	2,119	181	2,762	9,139	608	787
Eastern district:											
Boston.....	134	185	182	7,345	65	187	2	245	1,007	179	99
Buffalo.....	76	197	49	28	24	72	6	138	559	90	71
New York.....	4,128	2,643	737	11,830	188	307	45	109	8,457	306	2,542
Philadelphia.....	137	94	24	638	74	134	1	225	689	136	39
Porto Rico.....	295	405	167	2,085	17	11	1	752	1,648	534	194
Savannah.....	32	3	0	0	155	241	0	555	986	25	67
Washington.....	38	19	1	1	314	378	76	748	1,574	162	108
Total.....	5,140	3,546	1,160	21,927	837	1,330	131	2,772	14,920	1,432	3,120
Western district:											
Denver.....	8	12	5	260	39	47	1	147	259	8	7
San Francisco.....	333	497	77	13,814	133	174	15	1,198	2,428	462	116
Seattle.....	156	256	26	8,401	95	83	3	477	1,096	186	73
Honolulu.....	6	36	0	786	0	1	0	37	80	36	0
Total.....	503	801	108	23,261	267	305	19	1,859	3,863	692	196
Grand total.....	6,008	4,660	1,282	46,515	4,478	3,754	331	7,393	27,922	2,732	4,103

The service and regulatory announcements published during the year contained 46 opinions and 1,250 notices of judgment. The following six food inspection decisions were issued:

No. 171. Macaroni, Spaghetti, Vermicelli, Flour Macaroni, Flour Spaghetti, and Flour Vermicelli.

No. 172. Condiments other than Vinegars and Salt.

No. 173. Canned Vegetables, Canned Peas, and Canned Pea Grades.

No. 174. Baking Powder.

No. 175. Colors in Food.

No. 176. Evaporated Apples.

Of these, all but No. 175 are based upon recommendations of the Joint Committee on Definitions and Standards.

The control of shipments of polluted or spoiled food products has continued a major project of the bureau. In controlling and preventing the shipment of decomposed shell eggs the bureau has cooperated with the United States Food Administration and with the State and municipal food officials in developing a plan to prevent the shipment of uncandled eggs. This has resulted in the speedier consignment of eggs to market, with a consequent prevention of spoilage and saving of shipping space formerly occupied by inedible

eggs. It is reported that never before have the eggs arriving in the market been of so uniformly high quality.

Continued attention has been given to the sanitary supervision of the milk supplies at certain points receiving milk in interstate or foreign commerce. At the same time steps have been taken in cooperation with the local officials to improve the very poor sanitary conditions in some of the milk condensaries. The standardizing of milk for condensing purposes has been investigated. A large amount of work in connection with the examination of samples of condensed milk has been performed for the information of the Quartermaster's Department of the Army, the United States Food Administration, and the allied Governments.

With a view to preventing the shipment of polluted clams by the methods which have been largely successful in preventing the shipment of oysters from polluted beds, a study of the clam industry has been begun.

The work begun in other years to prevent the packing of decomposed tomato stock has been continued and extended, and steps have been taken, in cooperation with local officials and with the manufacturers themselves, to improve the sanitary conditions of the packing plants. The adulteration of canned tomatoes with added water has also received much attention.

The extensive use of corn meal and corn flour as a substitute for wheat flour has made it necessary to give attention to shipments of spoiled corn meal which have deteriorated, owing to unfavorable conditions of manufacture, storage, or shipment.

As already indicated, scarcity of supplies and high prices have made it necessary to give much attention to types of food products which have not in recent years been especially subject to sophistication. For example, owing to the embargo upon olive oil, much so-called olive oil actually consisting wholly or very largely of cottonseed oil or corn oil has found its way upon the market. Drastic action in the way of seizure and criminal prosecution has been necessary to correct this type of violation.

The shortage in the apple crop during the past two years has occasioned the use of distilled vinegar as an adulterant, and it has been necessary, therefore, to give especial attention to shipments of vinegar.

The high price of eggs has brought forth a flood of so-called egg substitutes. As a general rule, these preparations consist essentially of a mixture of starch and baking powder, colored yellow, with or without added casein. They have neither the food value nor the effect of eggs in cooking or baking, and are sold under labels which bear extravagant claims as to their culinary value and at prices far in excess of their intrinsic worth. A study has been made of such egg substitutes, and action inaugurated.

The cessation of importations of gelatin led to the sale as edible gelatin of glue contaminated with mercury or zinc, a practice against which action was begun last year, and continued with success this year.

Much attention has been given to the adulteration of oats with barley, weed seeds, and screenings, and seizures and criminal prosecutions in such cases have been instituted.

The campaign against cottonseed meals adulterated with hulls, and cottonseed meals which are not up to the guaranty of protein and fat and are over the guaranty of fiber given upon the label has been continued. Though many cases have been made and conditions greatly improved, the situation is not yet entirely under control, so that this work will be prosecuted with vigor during the coming year. After a cooperative study with the Bureau of Markets, a "Notice to Shippers of Cotton Seed" was issued, outlining the position taken by the department relative to the illegality of the practice of returning, or deliberately adding, foreign matter to cottonseed.

Descriptive definitions have been announced for hominy feed, corn feed meal, alfalfa meal, ground cottonseed hulls, and cottonseed hull bran. Definitions for linseed meal, oil meal, old process oil meal, new process oil meal, and flaxseed meal have been suggested to, and tentatively adopted by, the Association of Feed Control Officials of the United States. Action has been taken against manufacturers who adulterate linseed meal with screenings oil feed. Tankage containing garbage has been found, and action has been taken against such products sold under a false guaranty of composition or adulterated with considerable amounts of sand and glass.

Investigation of rye milling has shown that there is little chance of the contamination of rye flour with ergot. This passes mostly into the screenings, and is used in poultry feed. Such poultry feeds are under investigation. Vigorous action has been taken against the illegitimate use of rice hulls.

The education of shippers of fruits and vegetables concerning the requirements of the net-weight amendment to the Food and Drugs Act was attempted. Also an extensive investigation of the canned-goods industry, with a view to the control of the practice of "slack filling," has been made. At the present time this practice of underfilling the can or of substituting water or brine for a portion of the food product which it should contain is especially pernicious, not merely because it may deceive and defraud the consumer, but also because it is accompanied by a waste of shipping space and of valuable basic material, such as tin and steel, of which there has been a shortage.

Food Inspection Decision 175, on "Colors in Food," which was issued during the year, amends Food Inspection Decisions 76, 117, 129, and 164 by adding to the permitted list four dyes soluble in alcohol and oil and more or less suitable for coloring butter and fats. No batches of these dyes have as yet been submitted for certification. Certification was, however, asked in all for 30,327 pounds of dyes, as compared with 46,802 pounds in 1916-17. The quantities of amaranth, erythrosine, and indigotine, for which certification was asked, were greater than in the preceding year.

One hundred and forty criminal prosecutions and 30 seizures were inaugurated against "quack" medicines, and increased attention was given these products when offered for import. In cooperation with the Public Health Service the traffic in "quack" medicines for the treatment of venereal diseases was surveyed in the vicinity of the cantonments. No evidence of an increased sale of such products in these localities was obtained.

As a contribution to the department's program to increase pork production a vigorous and successful campaign against fraudulent hog-cholera remedies was conducted.

The campaign to improve the practice of dispensing by retail pharmacists in the District of Columbia, which has been in progress for some years, has been continued. There is still room for some improvement in the practice of the druggists of the District of Columbia and of Porto Rico. Carelessness continues, so that a considerable number of cases have been referred to the courts. Moreover, the retail drug trade seems slow to adjust itself to the requirements of the new Pharmacopœia and the new National Formulary. Conditions, however, have in general improved. A few years ago the carelessness prevailing was so great that hundreds of prosecutions might have been brought had it not seemed wiser to cite as a warning in the less flagrant cases of carelessness and prosecute only in the more flagrant ones. It is believed that similar conditions have prevailed, perhaps still prevail, in many other sections of the country, and that the practice in the District of Columbia was not far from the average of the country when this campaign was begun. There is need that the drug-control officials of the country give more attention to the suppression of carelessness in pharmaceutical practice.

Carelessness was also found in the practice of physicians' supply houses. The products of more than 20 of these were examined, and many cases of deficiencies of the active ingredients were found, as well as not a few substitutions of a cheaper drug for an expensive one.

COOPERATION WITH STATE AND MUNICIPAL OFFICIALS.

One hundred and fifty-six cases were instituted by officials in 29 States under the Federal Food and Drugs Act, 61 criminal prosecutions, and 95 seizures. Among these there were 64 food cases and 1 drug case, as against but 9 food cases and no drug case last year, conclusive evidence that food-control officials are beginning to use the Federal act for the protection of their people in the manner in which feed-control officials have long availed themselves of it. It is thus evident that effective cooperation between Federal, State, and municipal officials is spreading.

The character of the "Clearing House Letter," described in this report for last year, has been changed to include not merely last-minute regulatory information but also plans or programs of work intended to be carried out month by month in the immediate future. Under the title of "The Monthly Review of the Bureau of Chemistry" it goes to about 400 officials. The Office of Cooperation of the bureau, with the help of the bureau's library staff, is compiling laws, regulations, definitions, and standards, both domestic and foreign, applicable to foods and drugs, for the use of officials.

Correspondence between the bureau and city and State officials has been far greater than during previous years, an indication that a much larger measure of educational work relating to food and drug control is being done than formerly, thus adding undoubtedly to the efficiency of city and State food and drug control. There have been many specific instances of cooperation between local officials and the bureau's field force.

IMPORTED FOODS AND DRUGS.

Figures indicating the extent of the import work are given in the table on page 4. New products obtained from countries that have not heretofore shipped to the United States and new varieties of the old from new sources continue to be offered. Many products, for example, African ginger and Argentine cheeses, have been arriving not infrequently in a decomposed, moldy, or wormy state, owing to the disturbed shipping conditions, which give rise to serious delays. Because of disorganization of the trade other materials continue to be poor in quality. For example, about 15 per cent of the importations of black pepper offered for entry were found to contain excess of dirt or shells. Among drug substitutes offered for entry may be mentioned: *Piptostegia pisonis*, offered for jalap (*Exogonium purga*), and found to contain 20 per cent of an active purgative resin, differing from other purgative convolvulaceous resins hitherto described; *Glycyrrhiza uralensis*, for licorice (*Glycyrrhiza glabra* var. *typica* and *glandulifera*); *Digitalis thapsi*, shipped from Spain for *Digitalis purpurea*; the single flowers of wild Roman camomile (*Anthemis nobilis*), for *Matricaria chamomilla*; *Pteris* sp., for sarsaparilla (*Smilax* spp.); pebbles and *Amomum* sp., for cardamom seed (*Elettaria cardamomum*); *Artemisia pontica* and *Artemisia arborescens*, for *Absinthium*; *Aethusia cynapium* leaves, for *Coirum maculatum*; *Cuprea* bark, for *Cinchona*; and spurious cantharides for the genuine. In cooperation with the United States Public Health Service, all importations of synthetic organic arsenicals were examined, and held to the standards prescribed by the Federal Trade Commission for domestic manufacturers licensed under alien enemy patents.

CONSERVATION OF FOODSTUFFS.

POULTRY AND EGGS.

A number of projects have reached such a stage that the results have been published in the following Department of Agriculture Bulletins: No. 565, "How to Candle Eggs"; No. 663, "The Installation and Equipment of an Egg-Breaking Plant"; No. 664, "The Prevention of Breakage of Eggs in Transit when Shipped in Car Lots"; No. 657, "A Wheatless Ration for the Rapid Increase of Flesh on Young Chickens."

SEA FOODS.

A part of the work on the preservation of fish by freezing has been published as Department Bulletin 635, "The Commercial Freezing and Storage of Fish." Under the title "A Chemical Study of Food Fishes," analytical data on the composition of 20 common species have been recorded. Analyses of 16 varieties of fish ordinarily shipped from Florida or the Gulf of Mexico coast, and of 20 varieties from the coast of California have been made. Some of these data will be used by the California State Council of Defense in a campaign to educate the people to eat more fish and sea foods. Accurate cost data on the best methods of preserving Pacific coast fish were secured. The most promising results were obtained in smoking sardines, kippering shad, and salting mackerel, rock cod, and

barracuda. Although the preservation of sardines by the Scotch cure was very successful, this product seems more suitable for home consumption than for shipment East, since lengthy storage tends to turn the oil rancid. The determination of the constants of the oil showed it to be quite unsaturated. Directions for the preparation of smoked sardines and also kippered shad have been widely distributed, and it seems likely that a fish-curing industry will shortly establish itself on the Pacific coast. Improved methods of drying fresh and salt fish have also been studied at Gloucester, Mass.

A report on the sardine industry of Maine, containing recommendations for better and more economical methods of operation, has been prepared. A paper on the formation of ammonia and amines in canned sardines during storage has been published. Special investigations on the proper methods to be followed in drying, salting, and frying sardines for canning have been made. Successful experiments were made on the prompt removal by vacuum of water from sardines after steaming and inverting, and on the various oils and blends of oils as possible substitutes for olive oil, which is now almost unobtainable. The use of traces of essential oils and highly flavored oils to make cottonseed and peanut oil more attractive for packing sardines promises to be of value. A study, with electric thermometers, of the "heating" of sardines on the boats did not confirm this popular idea. Better methods of handling fish before canning were introduced.

The feasibility of canning fish hard frozen immediately after capture has been investigated with a view to determining whether by this means canning operations might be made more continuous, especially in localities with a warm climate, such as the coast of the Gulf of Mexico.

DEHYDRATION.

Much work was done to assist in the establishment of an industry for the drying of fruits and vegetables, so that these perishable products may be carried over economically from the period of abundance to the period of the year when production all but ceases. Many methods of drying and many types of drying equipment were employed, and the collection of cost data, apparently at present unavailable, begun. Much attention was given to the preparation of the products for the drying operations, since in many cases the palatability of the final product is greatly influenced by the preliminary treatment. The best methods of storage and of preparation for the table were also investigated. In much of this work the bureau enjoyed the cooperation of the Sanitary Corps of the Army.

DEMONSTRATION.

There is little of the bureau's regulatory or investigational work that is not promptly demonstrated to the industry. This year, however, as food conservation and production measures, the educational work on poultry, eggs, and fish, and on the prevention of explosions and fires in thrashers, mills, and elevators, was prosecuted with especial vigor.

POULTRY AND EGGS.

Work in the Imperial Valley of California resulted in the shipping of a large crop of turkeys dressed instead of alive, with the saving of 10 or 20 per cent shrinkage in weight. Demonstrations of the handling of eggs for market and storage and of the fleshing of broilers, so that the cockerels not only paid for themselves but returned a profit and provided almost twice as much foodstuff as heretofore, contributed in making the hatch in California larger this year than ever before. In Texas similar demonstrations were held in 19 counties. In the Salt River and Yuma Valleys in Arizona and the Pecos River Valley in New Mexico demonstrations to increase the turkey crop have been begun. In cooperation with the State Agricultural College much has been accomplished in Arkansas. Extensive candling demonstrations have been given in Louisiana. Much success has been met with in improving the methods of handling eggs in Mississippi and Alabama.

Demonstrations on the best methods of fleshing poultry have kept practically all of the feeding stations in Tennessee and Kentucky open and filled to capacity, where last year a number were closed because of the high price of feeds and lack of knowledge on the part of the feeder as to how to use to advantage such feeds as were available. It has been estimated that during 1918 more than 1,000,000 pounds of chicken flesh, which otherwise would not have been obtained, will have been produced in these States.

Egg-candling campaigns have been conducted in Kansas, in cooperation with the State Agricultural College and the State Food Administration. Similar work to improve the handling of eggs has been done in Missouri and in Iowa, in cooperation with the State Agricultural College, the State Food and Drug Department, and the State Food Administration. A similar campaign was conducted in Nebraska.

FISH.

In cooperation with the Bureau of Fisheries and the United States Food Administration, a campaign to develop the fisheries on the Gulf of Mexico, especially on the western coast of Florida, and to distribute the catch in the cities of the Middle West, has been very successful. The bureau undertook to arrange for and supervise the shipment of fresh fish, and the Food Administration propaganda in the cities of Nashville, Louisville, and Indianapolis, as well as the fine quality and the moderate price of the fish, caused greater consumption than in previous years. A market for Gulf fish has now been created in these localities, where this year these fish will probably be moved in large quantities during the autumn and winter. As a consequence, the fisheries at Fort Meyer, Punta Gorda, and near-by ports have been active all summer, instead of practically closing down. Plans are being made to establish freezers at suitable places on the Gulf of Mexico, to prevent gluts due to heavy catches and to insure an even distribution of fish as well as its better condition on arrival at the market. One freezer is in process of construction. For another, which includes a well-equipped general plant, bids have been submitted to contractors. A third is under serious consideration. The bureau has also been able to straighten out diffi-

culties in transportation of fish in a number of localities, notably on the North Carolina and Virginia coasts, where the service to the northern markets was upset by the congestion of the railroads.

MILL AND ELEVATOR DUST EXPLOSIONS AND FIRES.

A general fire and explosion prevention campaign has been carried on in order to reduce the great losses due in many instances to lack of knowledge on the part of employees. At meetings held in various parts of the country mill and elevator owners and employees were shown, by means of moving pictures, lantern slides, and miniature dust explosions, the danger of dust explosions and fires, and were made acquainted with the circumstances under which they occur. Following the meetings the various mills and elevators were inspected and recommendations made to the managers and superintendents with reference to arrangements which appeared dangerous. The men were then asked, by means of special cards, to pledge themselves to take all possible precautions to prevent fires and explosions in the plants where they were employed. The signing of the cards was acknowledged by the department and appropriate cards sent to the men. Through posters, circulars, and the like, much publicity was given to the work, and, while from the nature of the situation it is as yet impossible to prove in figures that this educational campaign has resulted in the conservation of much grain and feed that might otherwise have been lost by fire, the impression prevails in the industry that such has been its effect.

An educational campaign was conducted among the thrashermen and farmers, particularly in the Northwest, on the methods of equipping thrashing machines with devices to prevent explosions and fires. These measures include systems for grounding the machine to carry off static electricity, the installation of especially devised suction fans placed on the machine, which not merely reduce the explosion fire hazard but also collect smut spores and improve the grade of grain by cleaning and removing dust and foreign materials, and the use of automatic fire extinguishers. As a result of the campaign the equipment of thrashing machines in the Northwest with explosion and fire prevention devices has become very general, and most of the manufacturers of thrashing machines are planning to make some of these devices standard parts of their equipment.

COOPERATION WITH WAR AGENCIES.

The Bureau of Chemistry has cooperated in many ways with the United States Food Administration. It has acted in a consulting capacity, furnishing technical information concerning trade practices, methods of manufacture, and the like, and it has in many instances, especially in the early days of the war, through its inspectors, made a number of special investigations. It has been instrumental in securing the cooperation of State and municipal food and feed control officials. It has assisted particularly the Food Administration's baking division, and it organized the supervision of commercial bakeries throughout the country, working through State and municipal officials. It has caused thousands of inspections of bakeries to be made, with the result that greater compliance with the baking regulations was secured than would otherwise have been possible.

This work has been very thorough in certain States where close cooperation between the Food Administrator and the local food-control officials existed. It has been less effective in those States where such cooperative relations could be less perfectly established.

The bureau has cooperated also with the Food Administration in the control of certain perishable products, in the control of the fat and oil supply, and in the control of canned goods, especially with a view to the conservation of tin plate.

It has also cooperated in the control and licensing of the arsenic and insecticide industries. As a result, an adequate quantity of such insecticides was made available.

In this connection it may be mentioned that the control by the War Department of the acetic acid supply threatened to make it impossible for a Paris green to be manufactured. The bureau assisted in introducing the use of distilled vinegar for this purpose instead of acetic acid. It has cooperated also in controlling and licensing the ammonia producing and the fertilizer industries, a matter of much importance, since an equitable distribution of ammonia is necessary if both the refrigeration and explosives requirements of the country are to be met.

When war was declared the services of the Bureau of Chemistry were offered to the Quartermaster General, since it seemed that the organization of the bureau, with its laboratories scattered through the principal producing centers of the country, was eminently adapted to assist in the purchase and inspection of the vast quantity of food-stuffs and drugs needed by the Army. At first but little use was made of the bureau's facilities. Gradually the officers in charge of some of the quartermaster's depots outside of Washington requested representatives of the bureau to undertake the examination of supplies offered. Later similar requests were made in Washington. The volume of such requests has steadily increased until a vast amount of work of this nature is being done by the bureau. In these matters no responsibility has been placed upon the bureau, either with reference to the preparation of specifications, the letting of contracts, or the acceptance of deliveries. The bureau's function in these instances is largely limited to the objective report of the chemical or physical examination of the goods.

The demand upon the bureau's force, already greatly depleted, became so great that, in spite of the fact that a very large proportion of the time of the bureau's field force was given to this work, it became necessary for the Quartermaster's Department to assign a limited number of additional men to the various laboratories of the bureau. These chemists work under the immediate supervision of the chemists in charge of the laboratories. The work, having developed gradually as a matter of evolution rather than according to a predetermined plan, resulted in a not inconsiderable amount of unnecessary work and duplication. In consequence it has become necessary to establish in the bureau a special office to deal with the relations between the bureau and the Quartermaster's Department, in so far as food and feedstuffs are concerned. At the same time, for the more expeditious conduct of this work, it will be necessary to establish special laboratories in localities in which the bureau now has no laboratories.

As a supplement to the chemical and physical examinations which have heretofore been requested, the bureau was asked to undertake examinations by way of factory inspection. A large amount of work has been done for the Quartermaster's Department upon the waterproofing, mildewproofing, and fireproofing of various materials, and a large quantity of such materials has been tested. Many examinations of bag, strap, harness, belting, upper, and sole leathers have been made, and investigations have been conducted on the suitability of leathers for certain special purposes. Also, a great number of samples have been tested. In addition, much work has been done for this department on the baling of goods and on shipping containers for overseas.

Very excellent cooperative arrangements have been established with the Sanitary Corps of the Army. A predetermined plan, which in practice has proved satisfactory, was developed almost with the organization of the food section of that corps. The field laboratories of the bureau were placed at the disposal of that section for use in making nutritional surveys at the cantonments, for the elimination of waste, and for the improvement of the dietary. In this connection the bureau's field force examined a large variety of materials, varying from garbage to the foodstuffs that are privately purchased by the enlisted men in the zones about the cantonments. The Sanitary Corps placed in those laboratories, in which the volume of work required was excessive, officers well trained in methods of chemical analysis, some of whom were formerly members of the Bureau of Chemistry. The bureau has cooperated also with the Sanitary Corps in the matter of the dehydration of fruits and vegetables, and this corps has placed in the laboratories of the bureau men to assist in the securing of properly prepared and satisfactory dehydrated products. For the Surgeon General of the Army the bureau has undertaken to manufacture and supply the rare sugars which are required in some quantity and variety for the use of the bacteriologists of the Medical Corps.

Much of the chemical research and development work required by the Bureau of Aircraft Production has been placed under the supervision of the Bureau of Chemistry. This work has become so extensive that a number of men have been detailed to it by the Bureau of Aircraft Production. In this manner the Bureau of Chemistry has assisted in securing photographic chemicals and, as indicated elsewhere (p. 15), it has undertaken the production of sensitizing dyes which are so necessary in photographing under certain adverse conditions of illumination. Through its field laboratories it has examined many shipments of castor beans and castor oil offered for entry with a view to determining whether they are suitable for use in the preparation of lubricants. It has assisted in the study of airplane "dopes." It has investigated and reported upon the operation of a number of plants producing materials required in airplane manufacture, especially certain alcohols and ketones.

Laboratory space and manufacturing equipment have been turned over to the various branches of the War Department for their use.

Several members of the bureau have served on important committees of the War Industries Board, and in a number of instances

the bureau, through its inspectors, has furnished information to that board.

The bureau has furnished the War Trade Board with experts who have devoted the greater part of their time to assisting that board in considering requests for export and import licenses for chemicals.

The bureau has assisted the War Department in a number of ways of value in connection with gas warfare.

TECHNOLOGICAL INVESTIGATIONS.

DUST EXPLOSIONS.

In cooperation with The Pennsylvania State College, Department Bulletin 681, "Grain-Dust Explosions: Investigation in the Experimental Attrition Mill at The Pennsylvania State College," was issued. The inflammability of a number of dusts has been determined and an experimental apparatus developed to study the ignition by different means of dusts in suspensions of varying densities. The effect of moisture content upon the inflammability of oat-hull by-products has been investigated. Arrangements have been made with two industrial companies to test the practical value of passing inert gases containing too little oxygen to support combustion into grinding machinery as a preventive of explosions.

Various methods of designing milling equipment, to prevent the accumulation of static electric charges, have been proposed. Many special investigations of explosions and fires in grain mills, elevators, food plants, and storage warehouses were conducted to establish the specific cause and to develop methods of prevention. The numerous fires in the cotton gins of the Southwest last year led to a preliminary investigation which indicates that possibly static electricity may be a causative factor in these disasters. The matter will be pursued further during the coming season.

COLOR INVESTIGATIONS.

The guiding principle in this work is that the mechanisms of organic reactions and the laws that govern them should be studied, as well as the practical details of manufacturing processes. For these studies the works chemist has neither leisure nor opportunity. Yet such fundamental knowledge is vital to the progress of the industry. For example, the industry is seriously hampered by the lack of suitable quantitative methods for the determination of many of the substances with which it deals. It is, therefore, difficult for the works chemist to exercise such exact control over many of the processes as will yield the maximum amount of the desired product. Consequently much attention is being given to the development of quantitative methods for the determination of the more important substances. Furthermore, chlorination, sulphonation, and oxidation, especially in the vapor phase, and the behavior of catalysts have been made the subject of experimental and theoretical studies which already have yielded what promise to be new methods for the production of phthalic anhydrid, H-acid, and benzaldehyde and benzoic acid. Of these, the process for making phthalic anhydrid is being developed commercially in a satisfactory manner.

Methods have been devised for chlorinating, sulphonating, and nitrating cymene, and numerous useful compounds and dyes have been prepared from it. Cymene is a hydrocarbon obtained as a by-product from the sulphite-spruce paper industry. Two million gallons per annum are estimated to be available. No commercial use is now made of it. A paper on the nitration of paracymene has been published.

New methods for refining anthracene pressed cake have been devised, and processes for obtaining pure anthracene, phenanthrene, and carbazol are in an advanced stage of development. Improvements have been made in the methods for purifying anthraquinone. Inasmuch as these projects required that vapor pressure measurements upon a large number of compounds be made, a new dynamic method for measuring vapor pressures was developed.

A large number of dyes necessary for the sensitizing of gelatin emulsions of silver halids required in photography are being prepared and studied in cooperation with the Bureau of Aircraft Production and the Bureau of Standards. The production of a large number of quinolines used in the synthesis of these sensitizing dyes is in progress.

A number of dyes useful in biological research are being prepared and studied. Among them are included known and new sulphophthaleins for the measurement of the hydrogen-ion concentration of solutions and vital red required in considerable quantities by the Surgeon General for certain blood studies.

A compilation of the literature of all American patents on dyes is in an advanced stage of preparation.

Five patents based on work of the Color Laboratory have been allowed and a number of others are pending.

NAVAL STORES.

Data on the extent of adulteration of turpentine and misgrading of rosin for the last three years have been compiled. Information on the commercial weighing of naval stores has been gathered. Observations which indicate that adhesives containing rosin in combination with various oils can be used satisfactorily in the manufacture of fiber and wall board requiring special waterproof properties have been made. Glass rosin type samples have been deposited with the Chamber of Commerce, Pensacola, Fla., and with the United States Food and Drug Inspection Station, Boston, Mass. The British Government Inspection Bureau has been assisted in purchasing rosin.

The description of a simple colorimeter for determining the color grade of turpentine has been published. A satisfactory process of refining wood turpentine applicable to the commercial plant has been developed.

LEATHER, TANNING, AND FINISHING MATERIALS.

Data on the wear resistance of leather from different parts of the hide have been published, and a report on a mechanical wearing test of shoe-soling materials is in press. The description of a volumometer specially designed in this connection has been printed. A bulletin on domestic sumac, giving detailed directions for the proper gathering and curing of sumac, has been published.

In cooperation with the War Industries and Shipping Boards, plans have been made to endeavor at several plants to recover chromium from the waste chrome liquors. The procedures for the purification of tannery effluents advocated by the bureau are in successful commercial practice.

Extensive experiments on the effect of various treatments on upper leathers, undertaken primarily for war purposes, will furnish information of value to both tanner and user of leather. In this connection an accelerated aging test by exposure to ultra-violet light is being tried.

MILDEWPROOFING.

Information on mildewproofing which has been gathered for some years past for the benefit of farmers has proved of value to the Quartermaster General. Several satisfactory formulæ have been developed, and several reliable methods for judging the mildew resistance of treated fabrics devised.

PAPER.

Assistance has been rendered the Navy Department in securing satisfactory blue and brown print paper, and a communication on "Blue and Brown Print Papers, Characteristic Tests and Specifications" has been made. Recommendations made to the General Supply Committee and other Government departments that lighter-weight blotting paper be used have been adopted. The conditions prevailing in the paper industry have helped the propaganda which for some years the bureau has been pushing to conserve paper-making materials through the use of lighter-weight papers.

The description of a photometer for the measurement of the translucency of paper has been made public.

CONTAINERS.

At the request of the Navy Department, the development of a water-resistant fiber shipping container, strong enough to substitute for the wood canned-goods shipping case, was attempted. Specifications for such containers were submitted to the Navy Department, and adopted in all essential particulars by the Fiber Board Manufacturers' Associations and by the Food Administration. Inasmuch as the usual paper-testing methods are not adequate for determining the utility of fiber board for shipping containers, a new impact tester has been developed for this purpose.

The War Department has been assisted in securing a satisfactorily wrapped bale for shipments overseas, and the specifications drawn for baling paper have been adopted by the War Department.

Because of a threatened shortage of tin plate, the possibility of using various types of fiber containers for certain foodstuffs ordinarily packed in tin was considered. The difficulty of securing importation of palm oil, considered essential for the manufacture of tin plate, led to an investigation of the use of hydrogenated cottonseed oil as a substitute for palm oil. It has been shown that palm oil is not essential for the production of tin plate. Cooperation with

the industry on the subject of proper steels for use in the manufacture of tin plate for food containers and on the rust-resisting qualities of different kinds of tin plate has continued.

RESEARCH.

PLANT CHEMISTRY.

The study of poisonous beans offered for import has led to the preparation of a monograph on the chemical and botanical characteristics of the edible and poisonous beans of the lima type, *Phaseolus lunatus*. Methods have been devised which, upon a laboratory scale, render such poisonous beans fit for food. If they are practicable on a commercial scale, these cheap beans may become available for food purposes. A very simple method for the isolation of the cyanogenic glucoside of these beans, linamarin, has been devised, and its enzymatic and acid hydrolysis has been studied.

In cooperation with the Bureau of Plant Industry, hundreds of samples of soy beans of different varieties, grown in various localities, have been examined to determine the range of variation in composition dependent upon variety and climate. The beans low in protein were generally high in fat, and vice versa, while the effect of climatic conditions seemed greater than the effect of variety in influencing composition. No correlation was found between the weight per thousand and the fat or protein content. In general, though there are some exceptions, varieties high in protein in one locality are also high in protein in others. Studies have also been made on the manufacture of palatable products from soy beans.

The study of various seeds offered for import as mustard has led to the preparation of a paper on Chinese colza, discussing the chemical and anatomical characters of the seed, as well as the morphological characters of the plant in different stages of growth. Similar work is in progress on other species of *Brassica*, such as Japanese mustard (*Brassica cernua*), Chinese mustard (*Brassica juncea*), and Russian brown mustard (*Brassica besseriana*). These, as well as white mustard (*Sinapis alba*), have been grown successfully in three localities in the United States.

As part of a cooperative study with the Bureau of Entomology on boll-weevil control, the bureau has published a paper on cotton entitled "Chemistry and Histology of the Glands of the Cotton Plant with Notes on the Occurrence of Similar Glands in Related Plants," and one entitled "On the Chemistry of the Cotton Plant, with Special Reference to the Upland Cotton, *Gossypium hirsutum*." The ethereal oil previously reported as occurring in the flowering and fruiting plant has also been obtained from young plants, mainly seedlings. It occurs in small amount, about 0.015 per cent, and is located in glands distributed generally over the plant. If unexposed to light the glands contain, in addition to the oil, gossypol; if exposed to light, quercetin or quercimeritrin. Both quercimeritrin and isoquercetrin could be found in the petals. Gossypitrin and gossypetin, isolated from other types of cotton, were not observed in Upland cotton.

Department of Agriculture Bulletin 568, "The Presence of Arsenic in Hops," and Bulletin 666, "The Effect of Alkali Treatment on Cocoas," have been issued.

In connection with a study of the adulteration of "soft drinks," a paper has been published on gingerol, the pungent principle of ginger, and on paradol, the pungent principle of grains of paradise.

The results of studies on the fertilizing value of stable manure treated with borax to destroy the larva of the house fly have been made public, under the title "Boron: Its Effect on Crops and Its Distribution in Plants and Soils in Different Parts of the United States" and "The Effect of Three Annual Applications of Boron on Wheat."

Articles upon the occurrence of manganese in insect flowers and insect flower stems, and also upon the effect of sodium nitrate applied at different stages of growth on yield, composition, and quality of wheat have been printed. An investigation upon the reduction of nitrates by seedlings has been completed.

A new method for the separation of the coloring substance from leaf greens has been devised, and spectroscopic studies have been made upon these color compounds. The determination of the composition of many of the salt-bushes and their allies has been completed. The data will be published in order to give information concerning the food value of these important forage plants of the semiarid Southwest.

CHEMISTRY AND NUTRITIVE VALUE OF PROTEINS.

As part of a study to establish criteria for judging the suitability of gelatins for food purposes, physico-chemical studies have been made of gelatin, some of the results of which are in preparation for publication. Complete hydrolyses have been made of kafirin, the chief protein of kafir, and of arachin, the chief protein of the peanut. The data have been published.

The results of the chemical examination of the globulin of buckwheat and of stizolobin, the globulin of the Chinese velvet bean, *Stizolobium niveum*, have been published. Stizolobin contains all the necessary basic amino-acids, and feeding experiments with the protein of the Chinese velvet bean have shown that this is biologically complete and is properly utilized by animals. A study of the relative nutritive values of many other kinds of beans was begun.

A chemical examination of the globulin of the coconut is in progress. This globulin, which constitutes most of the protein in the coconut, contains all of the basic amino-acids necessary for normal growth. Feeding experiments in progress with coconut press cake, and the isolated globulin of the coconut indicate that both the press cake and the globulin are biologically complete. This study is timely, since the copra-crushing industry is assuming much importance in the United States, and there is a great demand for coconut oil in its rapidly growing use in preparing the so-called butter substitutes. The feeding value of copra cake does not seem to be appreciated as yet in the United States. A proper appreciation of this feed by dairymen will assist in keeping a copra-crushing industry in the United States after the war.

SUGARS AND SIRUPS.

Bulletin 466, "Maple Sugar: Composition, Methods of Analysis, and Effect of Environment," has been issued. Methods for the preparation of xylose, rhamnose, arabinose, and maltose have been perfected. The preparation of dulcitol from galactose has been carried out upon a large laboratory scale. The optical-crystallographic properties of the pentose sugars and of the rare trisaccharid melezitose have been determined. Melezitose has been found to occur in large proportion in a manna from the Douglas fir, and has also been found in the free crystalline form in honey of the honey-dew type from Pennsylvania and Maryland. A number of articles have been published upon these subjects, as well as upon the acetates of certain sugars and upon the amides of certain oxy-acids.

Much progress has been made in learning the conditions for preparing carbon of high absorptive power for use in clarifying sirups. The methods for the clarification and filtration of sugar-cane sirup have been improved.

BEVERAGES AND VINEGAR.

Two papers have been published upon the carbonation of beverages and one upon the occurrence of manganese in water supplies. Department Bulletin 656, "Concord Grape Juice: Manufacture and Chemical Composition," has been issued, and a similar study upon white grape juice is in progress. Extensive, authentic data on American wines, accumulated through more than a decade, have been compiled and filed for reference, under the title "Wine Investigation: Composition and Natural Acid Reduction of Wines Made from Native American Grapes," thus closing this project. The investigation of the sectional, seasonal, and other variations in the composition of fermented apple juice (cider-vinegar stock), begun in 1916, has been extended. Some of the results have been tabulated for the benefit of food and internal-revenue officials. A study of the changes that cider undergoes during fermentation and prolonged storage and its subsequent conversion into vinegar in rotating generators has been published. As a conservation measure, studies were made upon the use of sugar substitutes in soft drinks. A series of papers on the subject has been published in the trade press, and the formulæ recommended are in actual use.

FRUITS AND VEGETABLES.

A study upon the composition of loganberry juice has been completed. The results of an investigation of the acid content of fruits and of a study of arsenic in sulphured food products due to the use of sulphur containing arsenic have been published. Department Bulletin 581, "Microscopical Studies on Tomato Products," correlating the amount of decayed material used in the preparation of tomato products with the appearance of these products under the microscope, has been issued. The general use of apple pomace and the preparation of pectin from apples and other sources has been studied. The use of pectin as a filler in the preparation of jellies and similar products and for the preparation of jellies from fruits which contain but a small amount of pectin is growing, and brings with it a number of problems demanding solution.

CEREALS AND FLOUR.

Department Bulletin 570, "The By-Products of Rice Milling," and Bulletin 634, "A Physical and Chemical Study of the Kafir Kernel," have been issued. Studies on the composition of grain sorghum kernels, and on the milling and baking of flour from einkorn, emmer, spelt, and Polish wheat have been published, and a manuscript entitled "The Composition of Wheat Flour Substitutes and the Breads Made Therefrom," has been prepared for publication. A study of flour, under way for some years, has shown that there is a definite relation between the commercial grades of flour and the number of offal particles present. The increased use of flour substitutes has made their intensive study necessary for the purpose of preparing definitions and standards for these increasingly important products.

FOOD FLORA, SPOILAGE, AND FERMENTATION.

The Microbiological Laboratory has been accumulating a large number of living cultures of various strains of the organisms that are to be found upon foodstuffs, and especially those that are concerned with food spoilage. In this work the foundation is laid for a better knowledge of the flora of foodstuffs and its relation to food spoilage, the results of which will be compiled in a series of papers dealing with groups of organisms. Such a paper has been issued under the title "*Aspergillus Fumigatus*, *A. Nidulans*, *A. Terreus*, N. Sp., and Their Allies." Moreover, it has been learned that certain species of *Fusarium* and one species of *Aspergillus* are concerned in the destruction of the germinal area of the corn kernel, if the corn is stored with a very slight excess of water.

In studying food poisoning resulting from the growth of *Bacillus botulinus*, especially in its relation to canned foods, all known strains of this organism were brought together for comparative study. It appears that there is a series of closely related organisms capable of producing cases of food poisoning approximating the clinical picture of botulism. It will, therefore, be necessary to study a long series of cases and isolate and compare the significant organisms before the range of conditions under which these cases of serious poisoning are liable to occur can be known.

The results of the investigation of the organisms entering into the spoilage of canned sardines have been made ready to print. Among the observations made may be mentioned that while the gills of fish may contain the characteristic organism that produces spoilage, the intestines, when they are free from food, are practically sterile. Bacteriological studies have also been made of fish "slime" and of the transmission of organisms after death through the gill openings to the flesh of the fish. The protection afforded by the skin against bacterial invasion is also being studied.

The methods of judging frozen egg products have been analyzed critically. It was found possible to correlate closely the results of chemical and bacteriological examination with the appearance, the physical properties, and the flavor of eggs, as determined in the egg-breaking plant. This investigation should tend to clear up the difficulties that have arisen in the examination of frozen eggs for regulatory purposes. Studies also have been made upon the bacteria in storage eggs.

Reports on the chemical analyses of bacteriological bouillons and on a comparison of bacterial counts on whole and skimmed milk, separated and centrifuged cream, have been prepared.

With a view to improving the methods of vinegar production in the home from a wide variety of fruits, the acetic group of organisms has been studied, and, for the purpose of improving the production of soured foods, a study of the group of lactic organisms has also been conducted. A mass of data on the composition of silage has been gathered for the Office of Farm Management.

Studies upon the fermentation of the soy bean and the production of soy sauce have been in progress, and investigations begun upon sauerkraut production three years ago have been extended to include the pickling of numerous varieties of vegetables and fruits and the preservation of these vegetables by various forms of brining. Not only cabbage but potatoes, spinach, beets, string beans, sweet corn, and even peaches have been handled by this process in a satisfactory manner. In cooperation with the States Relations Service, Farmers' Bulletin 881, "Preservation of Vegetables by Fermentation and Salting," has been issued.

DRUGS AND PHARMACOLOGY.

The results of a study of commercial viburnum barks and preparations, and of Karaya gum as a substitute for tragacanth are ready to be submitted for publication. Observations on the leaves of *Eupatorium glutinosum*, offered for entry as "Peruvian matico," have been made public. Examination of the root of *Macrotomia cephalotes*, offered as alkanet, has shown it to yield a coloring matter similar to that of alkanet, but present in larger amount. A paper on this subject is in press.

A study of the manufacture of arsphenamine and of the patent literature on the subject has been completed.

Results of investigations on the pharmacology of oil of chenopodium, on the action of an isomer of caffeine, on the distribution and elimination of zinc and tin in the body, on the action of tartrates, citrates, and oxalates, on the influence of diet on the toxicity of sodium tartrate, on the production of glycosuria by zinc salts, on the action of succinate and its hydroxy derivatives have been published.

OILS AND FATS.

In cooperation with the Bureau of Plant Industry, the oil yields of a large number of samples of peanuts of different varieties, grown in various localities, have been examined, and a report on the results prepared. A preliminary analysis of the results seems to indicate that there is very little relation between the volume, weight, and oil content of the nuts. Analyses of okra-seed oil, papaya-seed oil, cantaloup-seed oil, lemon-seed oil, arcca fat, tea wax, sugar-cane wax, squash-seed oil, cob-nut oil, licania-seed oil, and the oil of *Aleurites triloba* have been completed. The results of an investigation on the oil of salmon as a method for the determination of the species in the canned product are in press.

INSECTICIDES.

An investigation of the decomposition of di-lead arsenate by water, the results of which have been published, has demonstrated how injury may take place when treated foliage is subjected to the frequent action of light rains, fog, and dew. In cooperation with the Bureau of Entomology, the action of pure arsenious oxid, arsenic oxid, di-lead and basic lead arsenate, and calcium arsenate have been tested on various insects. A number of new calcium arsenates have been prepared and their chemical and physical properties investigated. Methods for preparing the two most promising—tri-calcium arsenate and calcium meta-arsenate—on a manufacturing scale have been developed, and a patent covering methods for the commercial preparation of tri-calcium arsenate has been obtained. The results of an investigation to determine whether fruits sprayed with Bordeaux mixture may retain enough copper to be objectionable are in process of preparation. A similar study has been made upon the retention of hydrocyanic acid in foodstuffs that have been treated with this gas for the purpose of destroying insects. The work on the poisoning of bees by sprays is to be published by the Bureau of Entomology. The efforts to modify the formula for Bordeaux mixture have progressed to such a point that it is possible to say that in all probability a formula which will contain much less copper than the present formula can be used for potatoes. The results obtained in the study of the adhering qualities of various copper and sulphur fungicides are to be published by the Bureau of Plant Industry. A report upon plants used as insecticides is in press.

ANALYTICAL METHODS.

There have been published methods for the separation of aluminum from iron by means of ether; for the preparation of heavy leathers for analysis; for measuring the absorption of paper; for the estimation of anthraquinone; for the detection of added color in butter and oleomargarine; for the determination of arsenates in insecticides by potassium iodate; for the estimation of fat in condensed milk and milk powders; for the detection of added water in milk by means of a simplified molecular concentration constant; for the analysis of acetylsalicylic acid and adulterants; and for the determination of the volatile oil content of citrus fruits.

There are in press papers upon the estimation of theobromin; of loosely-bound nitrogen as ammonia in eggs; of copper in insecticides; of copper and zinc in gelatin; and of vanillin and coumarin in factitious vanilla extracts. There are also in process of publication papers upon the evaluation of hexamethylene-tetramine tablets; upon the gravimetric and volumetric determination of zinc precipitated as zinc mercury thio-cyanate; upon the identification and determination of potassium guaiacol sulphonate; upon the separation and quantitative determination of the lower alkylamines in the presence of ammonia; and upon the application of the cryoscopic method for determining added water in milk.

Investigations have been completed upon the determination of acetic acid, methyl alcohol, and acetone in pyroligneous acid; upon the limits of sensitiveness of the United States Pharmacopœia method

for the determination of lead in zinc oxid; upon a new method for the determination of caffeine of general applicability; upon the determination of saccharin; and on the determination by the Kjeldahl method of nitrogen in certain organic compounds.

The food or drug analyst frequently faces the difficult problem of identifying a substance isolated from complex mixtures in very minute amount and in no high degree of purity. This is especially true in the identification of active principles in the course of the analysis of medicines. The analysts in these cases depend either upon a physiological test or upon more or less vague color reactions. From time to time efforts have been made to introduce the use of the microscope in identifying crystalline materials. Inasmuch as the mere appearance of crystals is not necessarily characteristic, the use of the microscope has been of value only to a limited extent. In recent years methods have been developed for the exact measurement of very minute crystals and also for the determination of the optical properties of such minute crystals. These optical-crystallographic methods hitherto have been applied in the main only to inorganic substances, more especially in mineralogy. It would seem that the same methods might be applied with great advantage in food and drug analysis. Therefore work was undertaken to modify the methods of optical-crystallographic study, as applied to minerals, so as to render these methods applicable to the substances met with in the work of the bureau. Department Bulletin 679, "The Application of Optical Methods of Identification to Alkaloids and their Compounds," giving the results of this investigation, was published. Work is now in progress to apply these methods of identification to specific groups of substances, so that in time the optical-crystallographic properties of a large number of substances, the identification of which is required in the course of food and drug analyses, may be recorded. The work upon one such group, the cinchona alkaloids, has demonstrated that these methods are eminently suitable for identifying or distinguishing from one another these closely related bases. The results have been published.

Incidental to this work, a study has been made upon the possible value of optical properties in tracing the configurations of organic substances. Some interesting results have been obtained and made public. In certain simple cases it was found possible to work out space lattices for organic compounds from a consideration of their optical and crystallographic constants. A note on the fundamental polyhedron of the diamond lattice has been published.

COLLABORATION.

The Bureau of Chemistry has cooperated with the Post Office Department in helping to secure fraud orders against a number of concerns marketing through the mails preparations with fraudulent medicinal claims. A number of frauds emanating from Chicago were suppressed.

It has also done much work for the Department of Justice.

The Tariff Board has been assisted in the compilation of data concerning imported chemicals and drugs.

Recommendations have been made to the Railroad Administration on the subject of standard refrigerator cars.

The Bureau of Markets has been assisted in its food survey project, the Bureau of Chemistry having handled the work in certain cities.

The General Supply Committee has been assisted, especially with reference to paper specifications.

In cooperation with the Bureau of Biological Survey, studies have been made on the best methods of poisoning rats.

REPORT OF THE CHIEF OF THE BUREAU OF SOILS.

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF SOILS.

Washington, D. C., September 11, 1918.

SIR: I have the honor to transmit herewith a report covering the operations of the Bureau of Soils for the fiscal year ended June 30, 1918.

Respectfully,

MILTON WHITNEY,
Chief of Bureau.

Hon. D. F. HOUSTON,
Secretary of Agriculture.

SOIL SURVEY.

Notwithstanding a certain amount of interruption in the work of the soil survey, due to war-time conditions, a larger area of detailed mapping was done during the fiscal year 1918 than during the preceding year, the area covered amounting to 38,136 square miles.

Prior to this year a total of 445,825 square miles had been mapped, so that the total area covered by the detailed work of the survey at the close of June 30, 1918, was 483,961 square miles. That part of the United States lying within regions where the rainfall is sufficient for crop production or where water is available for irrigation covers approximately 1,750,000 square miles. The area mapped in detail during 1918 was equal to approximately 2.2 per cent of this area, the total mapped in detail to date to 27.6 per cent, and the total, both detail and reconnoissance, much of the latter area calling for no further work, to 54.3 per cent of it.

Reconnoissance soil mapping was carried on in California only in 1918, where an area of 4,735 square miles in the southern part of the State was covered.

Of the 38,136 square miles mapped in detail, all except 4,429 miles, distributed in five States, was done in active cooperation either with some State organization or with some of the bureaus of the United States Government. Four of the five States in which no cooperation was given cooperated in this work in former years but were obliged to drop it for the present on account of war conditions. In a few other States no work was undertaken, owing to temporary inability of these States to continue active cooperation under existing conditions. At the close of the fiscal year active cooperation in soil-survey work was in operation with 22 States and with four bureaus of the Federal Government.

The statistical details of the work of the survey are shown in the accompanying tables.

Of the total area mapped in detail during the year, 11,936 square miles lay within the cotton belt, 4,410 square miles in the Pacific Coast States, and 21,790 square miles in the rest of the country.

Individual areas surveyed and mapped during fiscal year ended June 30, 1918.

DETAILED.

State.	Area.	Area surveyed.	
		Square miles.	Aeres.
Alabama.....	Marengo County.....	¹ 425	272,000
	Morgan County.....	¹ 436	279,040
	Shelby County.....	¹ 266	170,240
Arizona.....	Gila Valley area.....	¹ 55	35,200
Arkansas.....	Lonoke County.....	216	138,240
	Perry County.....	296	189,440
California.....	El Centro area.....	530	339,200
	Grass Valley area.....	² 436	279,040
Delaware.....	Kent County.....	437	279,680
Florida.....	Flagler County.....	³ ⁴ 157	100,480
	Orange County.....	413	264,320
Georgia.....	Early County.....	504	322,560
	Floyd County.....	490	313,600
	Mitchell County.....	¹ 121	77,440
	Pierce County.....	605	387,200
	Pulaski County.....	255	163,200
Idaho.....	Nez Perce-Lewis Counties.....	918	587,520
Indiana.....	Adams County.....	337	215,680
	Lake County.....	¹ 386	247,040
Iowa.....	Blackhawk County.....	¹ 471	301,440
	Buena Vista County.....	571	365,440
	Hamilton County.....	576	368,640
	Henry County.....	¹ 172	110,080
	Linn County.....	720	460,800
	Montgomery County.....	424	271,360
	Wapello County.....	432	276,480
	Wayne County.....	136	87,040
	Winnebago County.....	103	65,920
Kentucky.....	Logan County.....	230	147,200
Louisiana.....	La Salle Parish.....	¹ 197	126,080
	Sabine Parish.....	389	248,960
Maine.....	Caribou area.....	¹ ⁵ 180	115,200
Maryland.....	Baltimore County.....	650	416,000
	Washington County.....	450	288,000
Minnesota.....	Stevens County.....	557	356,480
Mississippi.....	Choctaw County.....	112	71,680
	Lamar County.....	243	155,520
	Pearl River County.....	797	510,080
	Pike County.....	408	261,120
Missouri.....	Knox County.....	¹ 391	250,240
	Lincoln County.....	607	388,480
	Reynolds County.....	250	160,000
	Texas County.....	¹ 649	415,360
Nebraska.....	Chase County.....	899	575,360
	Cheyenne County.....	202	129,280
	Morrill County.....	¹ ¹ 125	720,000
	Phelps County.....	538	344,320
	Sheridan County.....	402	257,280
	Wayne County.....	¹ 233	149,120
New Jersey.....	Belvidere area.....	¹ 295	188,800
	Millville area.....	¹ 354	226,560
	Toms River area.....	113	72,320
New York.....	Chenango County.....	230	147,200
	Oswego County.....	966	618,240
	Saratoga County.....	823	526,720
North Carolina.....	Bertie County.....	¹ 157	100,480
	Caldwell County.....	512	327,680
	Hoke County.....	460	294,400
	Orange County.....	390	249,600
	Wilkes County.....	462	295,680
North Dakota.....	Sargent County.....	¹ 636	407,040
Ohio.....	Mahoning County.....	¹ 87	55,680
	Wayne County.....	557	356,480
Oklahoma.....	Canadian County.....	¹ 721	461,440
Oregon.....	Yamhill County.....	714	456,960
Pennsylvania.....	Lycoming area.....	202	129,280
	Mercer County.....	¹ 559	357,760
South Carolina.....	Horry County.....	566	362,240
	Lexington County.....	474	303,360
	Newberry County.....	¹ 459	293,760

¹ These figures do not include portions of these areas surveyed in preceding years.² 33 square miles surveyed in July, 1918, but all counted in fiscal year.³ Portion of this county surveyed previous year as St. Johns County.⁴ St. Johns County mapped in 1917 contained larger area than published map on account of establishing Flagler County after survey was made.⁵ Reported as Aroostook area in 1917.

Individual areas surveyed and mapped during fiscal year ended June 30, 1918—
Continued.

DETAILED—Continued.

State.	Area.	Area surveyed.	
		Square miles.	Acres.
Tennessee.....	Maury County.....	1 180	115,200
Texas.....	Bowie County.....	1 588	376,320
	Denton County.....	1 446	285,440
	Freestone County.....	532	310,480
	Red River County.....	560	358,400
Virginia.....	Accomac-Northampton Counties.....	1 216	138,240
	Pittsylvania County.....	401	258,560
Washington.....	Spokane County.....	1,757	1,121,480
West Virginia.....	Barbour and Upshur Counties.....	719	460,160
	Webster County.....	262	167,680
Wisconsin.....	Jackson County.....	663	424,320
	Outagamie County.....	541	346,240
	Rock County.....	1 302	193,280
	Waupaca County.....	1 286	183,040
Wyoming.....	Fort Laramie area.....	546	349,440
Total.....		38,136	24,407,040

RECONNOISSANCE.

California.....	Upper San Joaquin area.....	4,735	3,030,400
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¹ These figures do not include portions of these areas surveyed in preceding years.

Areas surveyed and mapped in the several States during the fiscal year ended
June 30, 1918, and the areas previously reported.

DETAILED.

State or Territory.	Work during 1918 (sq. m.).	Work previously reported (sq. m.).	Total.		State or Territory.	Work during 1918 (sq. m.).	Work previously reported (sq. m.).	Total.	
			Sq. m.	Acres.				Sq. m.	Acres.
Alabama.....	1,127	44,504	45,631	29,203,840	New Hampshire.....	1,411	1,411	903,040	
Arizona.....	55	906	961	615,040	New Jersey.....	762	4,433	5,195	3,324,800
Arkansas.....	512	11,422	11,934	7,637,760	New Mexico.....		596	596	381,440
California.....	966	18,263	19,229	12,306,560	New York.....	2,019	15,752	17,771	11,373,440
Colorado.....		2,809	2,809	1,797,760	North Carolina.....	1,981	26,263	28,244	18,076,160
Connecticut.....		1,704	1,704	1,030,560	North Dakota.....	636	11,726	12,362	7,911,680
Delaware.....	437	749	1,186	759,040	Ohio.....	644	9,458	10,102	6,465,280
Florida.....	570	10,245	10,815	6,921,600	Oklahoma.....	721	5,819	6,540	4,185,600
Georgia.....	1,975	20,224	22,199	14,207,360	Oregon.....	714	1,965	2,679	1,714,560
Idaho.....	918	2,191	3,109	1,989,760	Pennsylvania.....	761	14,368	15,129	9,682,560
Illinois.....		6,770	6,770	4,332,800	Porto Rico.....		330	330	211,200
Indiana.....	723	10,339	11,062	7,079,680	Rhode Island.....		1,085	1,085	694,400
Iowa.....	3,605	9,580	13,185	8,438,400	South Carolina.....	1,499	19,059	20,558	13,157,120
Kansas.....		9,016	9,016	5,770,240	South Dakota.....		675	675	432,000
Kentucky.....	230	3,668	3,898	2,494,720	Tennessee.....	180	8,545	8,725	5,581,000
Louisiana.....	586	12,436	13,022	8,334,080	Texas.....	2,126	27,068	29,194	18,684,160
Maine.....	180	2,017	2,197	1,406,080	Utah.....		1,951	1,951	1,248,640
Maryland.....	1,100	4,834	5,934	3,797,760	Vermont.....		1,175	1,175	752,000
Massachusetts.....		1,494	1,494	956,160	Virginia.....	620	8,482	9,102	5,825,280
Michigan.....		5,708	5,708	3,653,120	Washington.....	1,757	8,295	10,152	6,497,280
Minnesota.....	557	4,744	5,301	3,392,640	West Virginia.....	981	13,864	14,845	9,500,800
Mississippi.....	1,560	21,582	23,142	14,810,880	Wisconsin.....	1,792	13,616	15,408	9,861,120
Missouri.....	1,897	27,897	29,794	19,068,160	Wyoming.....	546	309	855	547,200
Montana.....		882	882	564,480					
Nebraska.....	3,399	15,261	18,660	11,942,400	Total.....	38,136	445,825	483,961	309,735,040
Nevada.....		235	235	150,400					

Areas surveyed and mapped in the several States during the fiscal year ended June 30, 1918, and the areas previously reported—Continued.

RECONNOISSANCE.

State or Territory.	Work during 1918 (sq. m.).	Work previously reported (sq. m.).	Total.		State or Territory.	Work during 1918 (sq. m.).	Work previously reported (sq. m.).	Total.	
			Sq. m.	Acres.				Sq. m.	Acres.
Alaska.....		31,768	31,768	20,331,520	Pennsylvania.....	41,405	41,405	26,499,200	
Arkansas—Missouri.....		58,000	58,000	37,120,000	South Dakota.....	41,400	41,400	26,496,000	
California.....	4,735	27,400	32,135	20,566,400	Texas.....	92,297	92,297	59,070,080	
Kansas.....		39,960	39,960	25,574,400	Washington.....	13,115	13,115	8,393,600	
Nebraska.....		53,064	53,064	33,960,960	Wisconsin.....	14,425	14,425	9,232,000	
North Dakota.....		39,240	39,240	25,113,600	Total.....	4,735	193,494	198,229	318,866,560
Ohio.....		41,420	41,420	26,508,800					

TRUCK SOILS.

The study of the relation of soils to truck crops was carried on during the year along the Coastal belt trucking section of the Carolinas and Georgia, the field work having been completed during the year. Work on the report for the Norfolk district was completed.

LAND CLASSIFICATION.

The land classification work in the national forests was carried on as usual, about 45 projects being examined and reported on. In addition to the routine studies such as have been in progress for some time, the question of the relation of soil character to the growth of forage vegetation was raised during the year, and one of the best-trained men of the service was assigned to that work. He covered a large area in southeastern New Mexico and southwestern Texas, where the forage question had become acute on account of the protracted drought in that region. The field work in this area was completed just at the close of the year and another study of a similar kind was begun in Utah. This work is being done in the national forests and in cooperation with the Forest Service. It has been necessary to extend it, in a place or two, beyond the forest boundary in order to obtain data for purposes of comparison.

OTHER COOPERATIVE PROJECTS.

Cooperative work was carried on between the soil survey and the Office of Indian Affairs in Arizona and Utah, with the Reclamation Service on two projects in Wyoming, and with the Bureau of Plant Industry in Maine.

At the request of the United States Geological Survey an experienced soil survey man was assigned to the study of the soil in the various areas being covered by their field parties, who were classifying the public lands of the United States in accordance with the provisions of the Enlarged Homestead Act. While it was clearly recognized that the basis of that classification is mainly the kind and density of the native vegetation, yet it was thought a study of the soil also, especially in so far as its content of organic matter, its depth, and its texture are concerned, might be of at least confirmatory value. The results seem to have justified the assignment on

that ground alone. It happens also that the regions covered have been those in which the previous knowledge of the soil in possession of the bureau was probably less than in the case of any other equally large area in the continental United States. The results have a very great value to the bureau, therefore, in its work of making a soil map of the United States. Its purely scientific value, in showing the relation of soil character to native vegetation, is of considerable value also.

ASSISTANCE RENDERED THE DEPARTMENT OF WAR BY THE SOIL SURVEY.

The work of the soil survey has been and still is carried on mainly in those parts of the United States having smooth topography and in which agriculture is the predominant industry. The greater part of such portions of the country were not covered by any base map of sufficient accuracy to be used for our soil survey mapping, a large part of the mapping done heretofore by the United States Geological Survey covering mountainous regions and regions where mining is the predominant industry. It has been necessary, therefore, for the soil survey to construct its own base map in such regions, it being essential in soil survey work to have a base map that is very full and accurate in its exposition of local cultural and drainage features and their local relation to each other and to the boundaries of the various soils. This has been more true, probably, of the Coastal Plain of the eastern and southern parts of the United States than of any other area of the country equally large. The maps published by the bureau covering counties in the region are, most of them, therefore, the best maps of those areas in existence, notwithstanding the fact that they do not attempt to show the nature of the topography.

When war was declared a year ago there was a strong demand for all the definite cartographic information about the country that could be obtained, the eastern coastal region receiving the predominant part of the attention. Our maps were in great demand, therefore, by various bureaus of the Department of War, copies of all our published maps were called for and in many cases advance information concerning areas the maps of which had not yet been published was supplied.

In addition to the data that are accumulated in the course of our work for our own use, the survey has undertaken to collect, through the medium of the soil survey field force, certain additional data of especial value to the Department of War, blanks for recording the information being furnished by that department and distributed to the field men.

Since the Department of War itself is now doing a great deal of base map making in certain parts of the country arrangements have been made by which an exchange of information will take place, we furnishing data to that department in areas covered by us, they supplying us with the base map data in areas covered by them, so that no duplication of effort will occur.

In addition to the above, some information has been furnished the department concerning the nature of the soil, in certain localities, required by them for specific purposes, though seemingly this very important information possessed in so great detail by the bureau has not been in so great demand as its value would seem to justify.

INFORMATION.

The section of soil information and advice has answered many inquiries and given much advice locally to persons asking it during the year. The demand for advice by persons desiring to plant gardens has been very great. This section has done much work in preparing an exhibit of the work of the bureau to be shown at a number of the more important agricultural fairs.

CHEMICAL INVESTIGATIONS.

The work carried on in the Division of Chemical Investigations during the fiscal year 1918 was along the same general lines as during the year preceding.

The number of miscellaneous samples submitted by other bureaus and by individuals for analysis continued to be large. For the most part these were samples of limestone, marl, or other lime-containing material submitted for an opinion regarding their suitability for liming purposes and samples of soil the lime requirement of which it was desired to know.

The analyses of carefully selected samples of American virgin soils begun last year has been carried on, and 28 samples involving 336 determinations have been completed. About 20 samples remain to be analyzed, and the work when completed will furnish information regarding the composition of American virgin soils not heretofore available.

Such research work as it has been possible to carry on has been confined for the most part to problems connected with the liming of soils. The work on the forms of lime in soils has been continued, and a beginning made on a study of diffusion of liming material through the soil. Progress has also been made on the study of the solubility of liming material as affected by impurities.

In connection with the work on liming, a Farmers' Bulletin (No. 921, "The Principles of the Liming of Soils") has been published.

FERTILIZER RESOURCES INVESTIGATIONS.

The fertilizer situation, owing to war demands, the decrease of importations, the congestion of traffic, and the unsettled labor conditions, has continued difficult with prices maintained at a high level.

The work of the division with reference to the fixation of atmospheric nitrogen has been carried on actively in cooperation with the Bureau of Ordnance of the War Department. The Haber installation for the production of synthetic ammonia was completed during the year and has been operated successfully. The War Department has recently requested the use of this installation for the purpose of testing various catalysts, and this work is being carried forward now by this division assisted by experts detailed from the Bureau of Ordnance. The mechanical difficulties connected with this process have been overcome completely and the possibility of producing synthetic ammonia by this method at a reasonable cost has been demonstrated.

In connection with the nitrogen-fixation work it became necessary to study the problem of oxidizing ammonia for the production of nitric acids and nitrates. The ordinary method of oxidation involves

the use of large quantities of platinum, and in existing circumstances platinum is not only very costly but also difficult to obtain. The possibility of oxidizing ammonia commercially by means of electrolytic cells was therefore taken up and studied actively throughout the year. This work was also carried on in cooperation with the War Department, which assigned chemists to work with the chemists of the Bureau of Soils. The fact that ammonia could be oxidized in this way with the production of ammonium nitrate as an end product has been clearly demonstrated and the relative efficiency of the process is being investigated. As a result of the work already done the indications are that this process operated in connection with the Haber process and thereby providing a market for the hydrogen liberated in the oxidation process can be operated commercially in competition with the Oswald method using platinum.

Efforts were made during the year to encourage the largest cities of the United States to utilize their garbage for the production of grease and garbage tankage. The mayors of all the larger cities not now possessing garbage-rendering apparatus were communicated with and their attention was called to the urgent need of both grease and fertilizer materials, with a request that they take steps at once to effect this conservation of waste materials. As a result of this work certain cities during the year have taken definite steps to install garbage-rendering plants.

With regard to phosphoric acid the research work of the division has been restricted during the year to the investigation of the possibility of smelting phosphate rock by some other means than electric power. Furnaces of different types have been designed and constructed, with the result that it is now believed a furnace has been found in which the smelting of the rock is satisfactory, with the evolution of phosphorus fumes. This furnace is now being tested. If satisfactory results can be achieved in this direction it will be possible not only to produce double acid phosphate more cheaply than heretofore, but what is probably of even more importance, it will be possible also to use mine-run material from the phosphate mines and thus avoid the heavy waste of phosphoric acid involved in the present methods of washing and screening the rock. The regular annual survey of the phosphate industry was also made and published.

The work of analyzing the raw materials and slags from the blast furnace industry, to determine if possible the amount of potash now volatilized and lost in that industry which might be collected for fertilizer, has been continued during the year. It is anticipated that this work, which involves a very large number of potash analyses, will be completed during the current fiscal year. It is evident from the work so far done that the amount of potash available from this source, if suitable collecting apparatus were installed at the blast furnaces, would be very large. Research work on several of the problems involved in the commercial collection of potash from cement kilns has been carried on in cooperation with several of the cement companies of the United States, and the results of this investigation have either been published or are now in press.

The bureau's experimental plant for the study of the commercial utilization of kelp as a source of potash has been in partial operation during most of the fiscal year. Large amounts of kelp have been har-

vested, dried, and passed through the experimental retorts, where the kelp has been charred with the evolution of combustible gas, ammonia, and tar. Apparatus for the leaching of the char and the evaporation of the resulting brine was installed during the latter months of the fiscal year, but is not yet operating with entire satisfaction. It is believed that the evaporation of the brine will not involve serious difficulties, as evaporation of similar brines is being carried on satisfactorily at several commercial plants. The new apparatus for effecting a satisfactory leaching of the char is at present being installed at the plant. Large amounts of dried kelp and kelp char have been sold on their potash content at the market price, and \$25,894 has been realized from this source. During the latter half of the year a chemist has been employed constantly on the examination of the tar and other distillates from the retorts in the effort to determine the best retorting conditions and the possible by-products recoverable from this source. With the practical completion of the plant it is believed that during the current fiscal year very important progress will be made in demonstrating whether or not it is commercially feasible to extract potash from the Pacific coast kelps.

It is gratifying to record that studies of the kelp plant during the year seem to show definitely that the kelp beds are actually improved by cutting off the mature growth. In southern California it has been demonstrated that beds which have been cut clean renew themselves and are ready for cutting again within three or four months. The disease which caused the total disappearance of certain beds in southern California waters a year ago has not appeared during the past summer in such degree as during the previous season, and operations have nowhere been seriously hampered by this cause. It is believed that prompt cutting of an infected bed has the effect of staying the progress of the disease.

The usual large number of samples of supposed fertilizer materials have been received by the division during the year and examined, and a large volume of correspondence on fertilizer matters has also been handled.

SOIL PHYSICS.

The personnel of the soil physics laboratory has been utilized as much as possible on war problems, only sufficient force necessary for routine analyses being maintained on this work. The other members of the division have been engaged on work on the synthesis of ammonia and the oxidation of ammonia, carried on in cooperation with the Division of Fertilizer Resources of this bureau and the Nitrate Division of the Department of Ordnance, United States Army. The production of synthetic ammonia is of fundamental importance from both a munition and a fertilizer standpoint, and is an emergency problem to the Ordnance Department. The work done in the Arlington laboratory has advanced far toward the solving of this problem.

REPORT OF THE ENTOMOLOGIST.

UNITED STATES DEPARTMENT OF AGRICULTURE,

BUREAU OF ENTOMOLOGY,

Washington, D. C., September 19, 1918.

SIR: I submit herewith a report of the work of the Bureau of Entomology for the fiscal year ended June 30, 1918. In accordance with your instructions, I have confined this report to concise statements of work performed during the year, with emphasis on the activities having a direct bearing on war problems.

L. O. HOWARD,

Entomologist and Chief of Bureau.

Hon. D. F. HOUSTON,

Secretary of Agriculture.

DECIDUOUS-FRUIT INSECT INVESTIGATIONS.

Investigations of deciduous-fruit insects have been carried out under the direction of Dr. A. L. Quaintance, as in preceding years.

APPLE INSECT INVESTIGATIONS.

CODLING MOTH.—Biological studies of the codling moth have been continued, and a large amount of experimental work has been done in orchards bearing upon various practical points in the control of this serious pest. Spraying experiments, carried on in cooperation with the Colorado Agricultural Experiment Station, in the Grand Valley of Colorado, have indicated that a schedule of six applications of arsenate of lead at the rate of 4 pounds of the powdered product to 200 gallons of water, with the addition of 4 pounds of fish-oil soap, will make a very effective treatment for the orchards in that valley.

In the Rogue River Valley, Oreg., the codling moth is not only seriously injurious to apples, but causes a large loss by injury to pears. Therefore, in cooperation with the Oregon Agricultural Experiment Station, extensive studies were undertaken in the fall of 1917 with headquarters at Medford. This work was begun so recently that it is too early to report results.

At the same time this bureau and the Bureau of Plant Industry established a joint laboratory at Bentonville, Ark., for the study of apple and other insects and diseases in that region. This work is meeting with the hearty cooperation of the orchardists. Other experiments are in progress in southwestern Missouri and in Arkansas, with Bentonville as headquarters.

Orchard spraying work is also being carried on, in cooperation with the New Mexico Agricultural Experiment Station, in the Pecos Valley, N. Mex. Here the effort is directed toward determining the comparative merits of different numbers of spray applications

and at different times under semiarid conditions. At four localities in the valley portions of orchards have been taken over by the department under cooperative arrangements with growers.

At all of these stations experiments to determine the comparative merits of dusting and liquid sprays are in progress. This side of the work has been especially keen at Winchester, Va., where it has been shown that, with certain varieties such as the York Imperial, which is little subject to apple-scab, dusting will be an effective substitute for spraying.

OTHER APPLE INSECTS.—Especial attention has been given during the year to the plant-lice occurring upon apple, and particularly to a certain group in which much confusion exists regarding the identity of species and the alternate host plants, this confusion standing in the way of remedial and preventive work. Valuable results have been reached.

The work which has been carried out on the apple-tree borers and other fruit-tree borers has been continued and will be brought largely to a conclusion this year. Studies have also been made of the apple curculio, the giant root-borer, various leafhoppers, the imbricated snout-beetle, the apple maggot, and others.

GRAPE INSECTS.

GRAPE-BERRY MOTH.—In northern Ohio the grape-berry moth work has been continued and materially enlarged. During the year especial attention has been given to the perfecting of a spray schedule and to the making of improvements in methods of application of sprays. There is some ground for belief that a single timely and thorough spraying will be sufficient, and if so this will do away with the objectionable spray residue on the fruit at harvest time. Dusting experiments also are being carried on in connection with this investigation, arsenate of lime being compared with arsenate of lead.

OTHER GRAPE INSECTS.—The so-called grape mealybug has become troublesome in parts of California, where its life history has been studied to practical completion, and a large amount of experimental work with sprays and other remedial measures has been carried on. This is a difficult insect to handle, since it secretes itself under shreds of bark where sprays can not reach it readily. The work on the grape phylloxera has been continued on a reduced scale, the effort being to determine the best means of disinfection of rooted vines and cuttings tied in bundles according to the usual nursery practice. A thorough survey of Fresno County, Cal., which has been carried on in cooperation with the Bureau of Soils, to determine the relation of soil conditions to severity of phylloxera attack, has been practically completed.

PECAN INSECTS.

Additional information has been gained regarding the life histories of important insect enemies to pecan, and especial attention has been given to the use of insecticides in orchards or groves in southern Georgia and Florida. Growers have actively cooperated. Work of this kind has also been carried on in southern Mississippi and in the vicinity of Brownwood, Tex.

INSECTICIDE INVESTIGATIONS.

Work under this project has been continued as in former years in cooperation with the Bureaus of Plant Industry and Chemistry, and has included the testing of miscellaneous proprietary insecticides, and further testing of insecticides developed by the bureau or others for use alone and in combination with fungicides. Further attention has been given to the determination of the range of usefulness of calcium arsenate on pome and stone fruits and grapes. Testing work is under way in Connecticut, Michigan, Virginia, Arkansas, New Mexico, Colorado, and Oregon. Working under these varied climatic and other conditions, the results, when available, should settle the points under investigation.

In view of the present high cost of arsenate of lead, orchardists and manufacturers have evidenced decided interest in arsenate of lime. Experiments thus far made indicate that it may be used in all situations where Paris green has been employed, and that for pome fruits it will be a satisfactory substitute for arsenate of lead when used with lime or fungicides containing lime.

Progress has been made in the investigation of the insecticidal constituents of plants, especially the so-called derris. This insecticide of oriental origin acts both as a contact and as a stomach poison. As a stomach poison it is efficient against only a few insects, while as a contact insecticide it is efficient against a wide range of insects. A detailed report on the subject is planned at the close of the growing season 1918.

Further tests have been made with nicotine as an agent for killing the eggs of insects, especially those of the codling moth. Results as a whole indicate an ovicidal action of nicotine, but not sufficient to give satisfactory control of the codling moth when used alone. Preparation of a report on the subject will be undertaken as soon as data for the present season's work are in hand.

Studies of the relative toxicity and physical characteristics of various arsenicals, undertaken in cooperation with the Bureau of Chemistry, are being continued and progress made. An extended report on insecticides, spraying apparatus, etc., has been issued as Farmers' Bulletin 908.

CRANBERRY INSECT INVESTIGATIONS.

The work on cranberry insects in New Jersey has been completed, and a Farmers' Bulletin (No. 860) covering the principal insect pests of this crop in that State has been published. Special articles on the more important species have been published or are in the course of preparation, and practical control measures have been developed for the principal pests.

An investigation of the insects affecting cranberry bogs in the State of Washington has been undertaken in cooperation with the agricultural experiment station of that State, beginning with the spring of 1918. Several of the important eastern cranberry-insect pests have been introduced into the Washington bogs with plants from the East with which the bogs were started, but it will be necessary not only to study these insects under their new far-western conditions but also to see whether native western insects will take to the

cranberry out there. It has already been shown that the methods of control of the blackhead fireworm effective in the East are also effective against this insect under the conditions in the State of Washington.

PEACH INSECTS.

Additional information on the use of fumigants in the control of the peach borer has been obtained. It now appears probable that by the proper use of para-dichlorobenzene, applied in small doses around the base of trees during the fall of the year, this pest may be controlled at a minimum cost; but further tests under a variety of conditions are under way. Positive recommendations probably will be made at the end of the present growing season.

On account of the interest aroused in the dusting of apple orchards, peach growers desire to know whether this method of insect and disease control is applicable to peach orchards. Therefore, in cooperation with the Bureau of Plant Industry, experiments have been carried on at Fort Valley, Ga., concerning the value of arsenate of lead and sulphur dust in the control not only of the plum curculio but of peach-scab and brown-rot. Similar experiments are in progress in Arkansas and at points in West Virginia, Maryland, and Michigan. Results are not yet available, but it is hoped that positive recommendations can be made before next year's spraying season.

The so-called oriental peach moth, mentioned in the last report as a newly established peach pest from Japan, has received particular attention. It has been found to attack not only peaches but apples, pears, quinces, plums, and cherries, and bids fair to be a serious pest. The present distribution of the insect is under investigation, and the facts will soon be placed at the disposal of State entomologists and others concerned with nursery and fruit quarantines. Posters showing the injury done by this insect have been widely distributed.

Much complaint has recently been received from Oregon of damage by the so-called California peach-borer. It appears that this insect at present is unusually destructive to prunes. An investigation has been begun.

NATURAL CONTROL OF DECIDUOUS-FRUIT INSECTS.

Investigations of the parasites of the grape-berry moth, under way for several years at North East, Pa., have been completed, and much additional knowledge has been gained. About 50 species of parasites of this insect have been found, only 7 or 8, however, of sufficient numerical importance to be at all effective. In the same way the insect parasites of other deciduous-fruit pests have been studied. Study of the fungous diseases of these pests and other insects has also been continued under this section of the bureau's work. This is a very promising line of investigation and encouraging results have been obtained. A new disease attacking the citrus mealybug of Louisiana has been discovered.

Similar work on the value of predatory insects in deciduous-fruit insect control has been carried on, partly in cooperation with the California State Horticultural Commission, since the need of more exact information in this direction has become very evident.

THE JAPANESE BEETLE (*POPILLIA JAPONICA*).

The recent introduction in the vicinity of Riverton, N. J., of the Japanese beetle (*Popillia japonica*), a serious insect pest in Japan, has resulted in an investigation of the insect by the Bureau of Entomology and an attempt at its eradication in cooperation with the New Jersey State entomologist. A laboratory for biological and other studies has been established at Riverton, and this place has been made headquarters for the eradication work.

It appears that the beetle was brought into this country in shipments of Japanese iris during the summer of 1911, probably in the egg or larva stage in the soil about the rhizomes of the iris plants. Some 625 acres are now heavily infested with the beetle, and it is scatteringly found over some 7,000 to 10,000 acres, with outlying infestations over not less than 25,000 acres.

The insect has been found to be a very general feeder, attacking grape, apple, cherry, buckwheat, sweet potato, corn, and many ornamentals and weeds, as smartweed, morning-glory, black locust, ironweed, etc. It has been recorded from a total of 41 plants.

The immature stages are passed in the soil, where the larvæ feed on decaying vegetable matter. The adults appear by midsummer, continuing until cool weather in fall. During hot days the beetles are strong fliers, which adds much to the danger of their spread. The insects attack the ends of ears of sweet corn, and in the movement of green corn to market can be scattered to various parts.

In the work of eradication several lines are followed, as the treatment of infested soil with sodium cyanid solution, the destruction of breeding grounds by plowing, and keeping the insects away from roadsides by the use of kerosene oil and other means. Direct measures against the beetles are taken by applying poisons as nearly as possible to the entire infested area, working from the periphery of the area inward. A large amount of hand picking is also being done and great quantities of the beetles have already been collected and destroyed.

CEREAL AND FORAGE INSECT INVESTIGATIONS.

Mr. W. R. Walton has continued in charge of this important section of the work of the bureau.

EUROPEAN CORN BORER.—Doubtless the most important development of the year with respect to insects affecting cereal crops was the discovery, late in the summer of 1917, that a very serious European pest of Indian corn had become established in eastern Massachusetts. This lepidopterous insect (*Pyrausta nubilalis*) is well known in Europe and Asia, where it occurs in injurious abundance throughout central and southern Europe and west central and northern Asia and Japan.

Among the cultivated crops attacked in these countries are corn, hemp, hops, millet, several wild grasses, and many common weeds. In this country corn is the principal cultivated crop seriously injured, but the damage to that crop is so serious as to cause the gravest apprehensions should this insect spread into the great corn belt of the Middle West. The caterpillars, of which there are at least two generations annually, bore into the stalk, ear, and tassel of the plant.

Thirty or more individuals often are to be found in one stalk during the latter part of the summer.

Vigorous action has been taken looking toward the control of this pest, and a cooperative investigation was initiated by State and Federal entomologists in order to determine the most effective means of dealing with it. At present the area known to be infested amounts to something more than 300 square miles. The Massachusetts State Agricultural College, State Board of Agriculture, and Foresters' Association, together with the members of the gipsy-moth investigational staff, are cooperating with the Branch of Cereal and Forage Insect Investigations of the bureau in keeping the insect under surveillance. Fortunately the insect passes the winter in the stalks of its host plants, and winter destruction is therefore possible, although extermination throughout its present range, on account of its numerous food plants, would be a matter of great difficulty and expense.

ALFALFA WEEVIL.—During the summer of 1917 the alfalfa weevil was discovered to have extended its range southeastwardly into the State of Colorado. The infested area, amounting to about 3 square miles, was located near Paonia, Delta County. Cooperative investigational and control work was at once organized by the State and Federal entomologists, and this outbreak is now receiving the most approved treatment. In Utah, southeastern Idaho, and southwestern Wyoming, where the insect has been present for some years and where control measures have been practiced for a considerable period of time, satisfactory conditions prevail. The natural enemies of the weevil, introduced from Europe in large numbers, have greatly increased in abundance and apparently are giving material aid in controlling the pest.

CHINCH BUG.—No general outbreak of the chinch bug has occurred during the year, although considerable damage throughout northern Texas occurred during the season of 1917. Surveys conducted throughout the winter in eastern and northern Texas indicated great danger of a continuation of the injury on a larger scale during the early summer of 1918, and an educational campaign was conducted in order to induce the farmers of Texas to begin to combat the insect early in the season. This movement was supported admirably and doubtless resulted in much good. The outbreak was further subdued by very heavy rains which occurred during the spring of the current year.

GRASSHOPPERS.—The summer of 1917 was remarkable for the severe and widespread injury by grasshoppers to forage crops throughout the Western and Northwestern States. The injury mentioned in last year's report was continued until the close of the growing season of 1917, and, owing to the unfavorable outlook, State and bureau forces were organized in North and South Dakota, Montana, Oregon, Washington, Colorado, Kansas, and Nebraska for the purpose of fighting the coming outbreaks of 1918. This cooperative movement undoubtedly has resulted in greatly reducing the losses which otherwise would have resulted. At present the indications point to a much less severe loss than occurred during the summer of 1917.

HESSIAN FLY.—The Hessian fly situation has continued to improve throughout the year. In eastern Kansas, where danger threatened during the fall of 1917, a cooperative campaign to secure the plowing down of stubble and the general observation of the safe planting date is believed to have been responsible, at least in part, for the greatly improved conditions which prevailed during the spring and summer of 1918. In Illinois, Indiana, and Missouri, where full advantage of the safe planting period was taken by growers, the current crops of winter wheat were excellent. Work on the experimental plats was continued and intensified during the year. Many new instruments were installed and two additional plats have been located, one at Forest Grove, Oreg., and the other near Carlisle, Pa. Investigations in the western half of the Mississippi River Basin have been reorganized and improved. The results obtained from the experimental plats have enabled the bureau to forecast Hessian fly conditions and thus to issue timely and valuable information.

CUTWORMS.—Several outbreaks of cutworms occurred during the summer months of 1917 in some of the Middle Western and Southwestern States. A notable outbreak of the granulated cutworm occurred in one of the irrigated sections of southern Arizona, where alfalfa is the staple forage crop. This outbreak was successfully treated by means of the poisoned baits. Experimental work with sawdust as a substitute for bran in such baits demonstrated the practicability of cheapening the mixture by the use of sawdust.

JOINTWORM.—Jointworm injury to wheat was unusually severe in the States of Michigan, Indiana, Tennessee, Virginia, and portions of Illinois during the year. The work of this insect doubtless was responsible for a considerably decreased yield of grain in these States. A new Farmers' Bulletin (No. 1006), giving advice for the control of the jointworm, is in process of publication. In Michigan, where injury has been general, the planting of rye instead of wheat is advised, because the former grain is not subject to wheat jointworm attack and gives a more satisfactory yield than wheat in that State.

COULEE CRICKET.—For several years past the Coulee cricket (*Peranabrus scabricollis*) has been responsible for progressively serious injury to crops in Grant County, Wash., and considerable sums of money have been expended by the State and county authorities in fighting it. During the spring of 1918 the bureau was enabled to provide an entomologist who could devote his entire time to the control of this pest, and as a result of his efforts, in cooperation with the investigational staff of the bureau, complete control was secured. Judging by present appearances little injury from this insect is likely to occur for some time to come. In case of a subsequent outbreak the methods originated and applied this year doubtless will prevent serious injury in the future.

SAWFLY INJURY TO WHEAT.—In July, 1918, an outbreak of a wheat-infesting sawfly occurred near Gaithersburg, Md., where it was responsible for rather serious injury to winter wheat. A preliminary survey subsequently conducted discovered the insect in northern Virginia and throughout most of Pennsylvania and Maryland. In appearance and methods of injury the insect resembled the wheat-stem sawfly, which at present is responsible for considerable injury to spring wheat in North Dakota and contiguous territory.

The insect responsible for the injury in the Eastern States above mentioned has been identified as *Trachelus tabidus*, a European sawfly. This insect is known to have been present in Pennsylvania since 1913, but appreciable injury to wheat has not been observed until very recently. Possibly the rapid multiplication of the insect has been aided by the recent movement for an increased production of wheat and the consequent planting of wheat for two or more years in succession on the same land. As is the case with the Hessian fly and the jointworm, this sawfly hibernates throughout the winter in the wheat stubble of the current year. An investigation of this insect has been started.

STORED-PRODUCT INSECT INVESTIGATIONS.

This section of the work of the bureau has been carried on during the fiscal year under the immediate charge of Dr. E. A. Back.

Because of the general needs of this country and of allied countries in the present crisis, the efforts of this section have been directed almost entirely toward the dissemination of information regarding the suppression of insects affecting stored food supplies, particularly the insect pests of beans, peas, corn, wheat flour, and food products made therefrom. Experts on the Pacific coast and in the South have been engaged in the inspection of many warehouses and mills where food supplies are stored.

Throughout the year large supplies of food that were being seriously affected by insects have been located. The owners of such supplies have been advised regarding the necessity for prompt action in order to avoid further losses, and have been shown how to prevent losses to newly acquired supplies that are free from insects. This service has been extended to farmers, particularly growers of corn and rice, whose crops suffer extensively through weevil attack.

Arrangements have been made with the Quartermaster Department of the Army at the port of New York whereby the bureau undertakes to make frequent inspections of food and clothing supplies intended for overseas shipment. The purpose of this cooperation is to keep the Quartermaster Department informed, through inspections made by experts, not only of the condition of food supplies purchased and delivered at the warehouses but also of their condition from time to time during the storage period. Such inspections detect and lead to the checking of insect ravages before the insects have had the chance to multiply and cause great losses. Much good has already resulted from this work, and as the warm weather continues the loss through insect attack will be greatly lessened.

INVESTIGATIONS OF INSECTS INJURIOUS TO VEGETABLE AND TRUCK CROPS.

The work on this group of injurious insects has been continued, as in former years, under the direction of Dr. F. H. Chittenden. The more important subjects of research have been insects injurious to potato, tomato, and related plants, to beans and peas, to sugar beets, and to sweet potato, especial attention having been given, under an emergency appropriation, to the study of the sweet-potato weevil in its occurrence in the Gulf States, with the object of control and eradication.

SWEET-POTATO WEEVIL ERADICATION AND CONTROL.

Following an urgent request, an emergency fund of \$30,000 was made available about March 1 for an investigation of the sweet-potato weevil in the States of Florida, Georgia, Alabama, Mississippi, Louisiana, and Texas, which might lead to its eradication and control. This has made possible a preliminary farm-to-farm survey of all outlying infested territory, definitely establishing the boundaries of infestation. A series of large-scale experiments in control have been undertaken at field stations in Texas, Mississippi, and Florida, and demonstration eradication projects have been initiated in portions of Florida, Georgia, Mississippi, and Alabama, the close survey accomplished having established the feasibility of operations for that purpose.

An educational campaign by inspectors has already been productive of much benefit and has reduced materially the number of infested farms in Georgia, Alabama, and Mississippi; indeed, it seems probable that the completion of another season's work may find the sweet-potato crop of the least infested of these States nearly weevil free.

Experiments with heat curing of sweet potatoes have shown the possibility of securing a mortality of 95 per cent of weevils in storage houses by carrying the tubers at a temperature of 115° F. for eight days. In badly infested districts in Texas, where weevil injury is frequently 50 per cent, losses have been reduced to less than 10 per cent by the timely application of arsenical sprays.

Life-history investigations have brought forward many interesting facts regarding this weevil which can be applied the coming season to excellent advantage. Good progress has been made in a survey of the wild food plants of the pest. On the whole, the beginning of the fiscal year 1919 finds the bureau well equipped to conduct a most effective campaign against this pest during the coming season.

OTHER INSECTS OF POTATO, TOMATO, AND ALLIED PLANTS.

The potato aphid, which was an unexpected pest in 1917, reappeared in still greater numbers in many regions in the early summer of 1918. It attacked both tomato and potato, and occurred along the Atlantic coast from Maryland and Virginia to New England and to a lesser extent westward to Ohio, Indiana, Illinois, Michigan, and Wisconsin. In Maryland it was controlled by nicotine sulphate used at double the strength generally advised for plant-lice. This doubling was necessitated by the greater resistance of the pest and by the unwillingness of the farmers to make a second spraying, on account of the scarcity of labor and appropriate spraying machinery. A still larger dosage, namely, one-half pint of nicotine sulphate to 50 gallons of water, was found desirable in New Jersey and Massachusetts.

The spinach aphid caused considerable loss to potato, tomato, cabbage, turnip, radish, beets, lettuce, and other truck crops. It covered practically the same territory and succumbed to the same remedies.

The potato flea-beetle, the three-lined potato beetle, and the potato fruitworm, as well as the common stalk-borer, were numerous and received careful consideration.

INSECTS AFFECTING GROWING BEANS AND PEAS.

An investigation of the bean ladybird—an insect which is to the bean crop of Colorado, New Mexico, and neighboring States what the Colorado potato beetle was to the potato crop in earlier years—was undertaken, and the results are available for publication. Additional experiments, however, are necessary for the control of this insect in order to lessen damage to the crop by the means of control themselves.

The pea aphid has been studied in California, as well as a pea moth which has been introduced during the year into Wisconsin, and two species of borers which affect especially Lima beans, one in the Southern States and the other in the Pacific region. Enormous areas in Lima beans and other beans were planted this year in southern California, and there has been a severe and unusual outbreak of the corn earworm upon the bean pods in that part of the country, necessitating careful studies of the conditions which have brought about the damage in the hope of preventing it another year.

OTHER TRUCK-CROP INSECTS.

The problem of the control of the onion thrips has been solved, and the department is now able to prescribe practically new methods of treatment which give excellent results. Some progress has been made in the control of the onion maggot by the use of sweetened sodium arsenate and arsenite in the destruction of the adult flies while depositing their eggs.

In the same way insects injurious to crucifers, such as the cabbage aphid, the false turnip aphid, and the harlequin cabbage bug, have been studied. The last-named pest, ordinarily an important one throughout the South, was largely controlled by the cold winter of 1918.

Work on insects injurious to strawberry, blackberry, raspberry, and related plants of the rose family has been continued in several States, and good results have been accomplished in the line of control of the leaf-rollers by arsenical spraying. A saving of at least 50 per cent was made in experiments in Iowa, and in Kansas a single spraying resulted in destroying two-thirds of the pests.

Investigations of insects as agents in the transmission and overwintering of the disease of cucurbit vegetables known as "mosaic" have been continued in Indiana and Wisconsin. Hundreds of individual insects were used in hibernation experiments, and about 100 experiments in control by insecticides are now under way.

The principal investigations of the insects affecting sugar beets have led toward the solution of the problem presented by the annual damage from the curly-top disease. It has been shown that a leafhopper is the agent responsible for the transmission of this disease, and studies of the life history and economy of the insect carrier have been nearly completed. These have led to experiments in the time of planting which have yielded results of such value that their application to commercial plantings will probably insure a paying crop in infested regions.

SOUTHERN FIELD-CROP INSECT INVESTIGATIONS.

Dr. W. D. Hunter has been in charge of these investigations, as formerly.

COTTON-BOLL WEEVIL KILLED BY POISON.—One of the most striking achievements of the bureau culminated during the year in the announcement of the value of powdered lead arsenate or calcium arsenate against the cotton-boll weevil. After years of experimentation the bureau is now able to announce that the weevil can be killed during the summer months by dusting the cotton with either of these poisons at the rate of 5 pounds per acre, with three to five applications at weekly intervals. The poisoning, to be most effective, should be done between 4 p. m. and 9 a. m., and the powder should be applied by means of a rotary dust gun or by power machinery. A special power machine has been developed which will cover nearly 200 acres per day. The cost of treatment is about \$1 per acre for one application. Distinct gains in yield of from 250 to 1,000 pounds of seed cotton have been obtained. It is hoped that the application of this discovery will greatly increase the yield per acre of cotton, one of the most important crops of the Nation.

OTHER COTTON INSECTS.—Other work on cotton insects, as indicated in the last annual report, has been carried on at Tallulah, La., Madison, Fla., and El Centro, Cal., the recent developments of cotton in the last locality, in the Imperial Valley, necessitating careful watch for cotton pests.

Research work on the pink bollworm of cotton in the Laguna district of Mexico has been carried on by experts of the bureau detailed to the Federal Horticultural Board, and will be mentioned in the report of the board.

OTHER SOUTHERN FIELD-CROP INSECTS.—On account of the extension of sugar-cane culture in southwestern Texas, a laboratory has been opened at Brownsville for the investigation of sugar-cane insects.

The investigations on tobacco insects, mentioned in the last report, have been continued.

The demands of the War Department for great quantities of castor oil led to very extensive planting of castor beans under contract in various southern States. Early in the season complaints began to come in of insect injury to these plantations, and the bureau has given especial attention to the control of these pests.

INSECTS AFFECTING THE HEALTH OF MAN AND ANIMALS.

With the beginning of the war, very elaborate tabulations and card indexes of the relationships of insects to the health of man and animals were prepared. This information has been placed at the service of the War Department and has enabled the bureau to give prompt service in many emergency cases. A close contact has been maintained with the sanitary officers, so that the bureau has been able to render service in the solution of certain camp problems.

Acting in cooperation with the National Research Council and the War Department, a study of the body louse was taken up and in-

vestigations have been made of all remedies proposed against the louse. Especial researches have also been undertaken in the search for new lines of treatment. Results of all tests are immediately communicated to the office of the Surgeon General of the War Department.

The chief of the bureau has been made chairman of the subsection of medical entomology of the National Research Council, and in this way all questions that arise are officially handled.

The work on insects affecting domestic animals, as outlined in the last annual report, has been continued. The insects frequenting packing houses and abattoirs have been under observation. Traps of different kinds have been experimented with, and the other lines of work indicated in the last annual report have been followed up.

INVESTIGATIONS OF INSECTS AFFECTING FOREST RESOURCES.

The work of the branch of Forest Insects, under the supervision of Dr. A. D. Hopkins, has been concentrated during the year on subjects which have a direct or indirect bearing on war-time needs.

Early in the year a conference was held with representatives of the branches of the War and Navy Departments, Shipping Board, etc., who are responsible for the supplies drawn from the forest resources of the country. The object of this conference was to offer the services of the bureau and explain how it could help through special investigations and advice toward preventing serious losses of forest resources from damage by wood and bark boring insects.

Recent investigations of logging and manufacturing operations in Mississippi to meet the demand for ash oars, handles, and other supplies, required by the war service, showed that one company had lost more than 1,000,000 feet of ash logs through failure to provide for prompt utilization after the trees were cut and thus prevent the attack of the destructive ash-wood borers.

There is a continued reduction of the heretofore serious losses of seasoned ash and other hardwood sap material from powder post, due to the more general adoption of the methods advised by the bureau. This has been accomplished largely through the adoption of methods of management by the manufacturers and shippers with little or no additional cost.

By far the most extensive insect-control reconnaissance that has been carried out to date is the "California survey," which was completed during the year. This was organized as a cooperative project in which a number of California lumber companies, the Forest Service, and the Bureau of Entomology were engaged. The general supervision of the survey was assigned to the assistant forest entomologist, Mr. J. M. Miller, who has charge of the Pacific slope field station.

The territory covered consisted of the pine belt along the western flank of the Sierra Nevada Mountains between the American and Kern Rivers. The results of this survey showed that the loss in 1917 from tree-killing beetles on the 1,682,000 acres covered was approximately 27,000,000 feet of merchantable timber with a stumpage value of \$60,000. If the recommendations of this bureau are adopted by the Forest Service and private owners and properly carried out, it is certain that a large percentage of this annual loss can be prevented,

and that through the application of the percentage principle of control it is entirely practicable to do so at a comparatively small cost.

In the Southwest, where the mesquite furnishes the only local supply of fuel, fence posts, etc., serious losses are suffered each year from wood-boring insects. Large quantities of mesquite are used for fuel at the Army cantonments, rendering the problem of especial interest in this connection. In order to determine a method of conserving the resources supplied by the mesquite, a special field station was established near Tucson, Ariz., at which mesquite has been cut every two weeks since October, 1917. The results of this experiment so far have been most gratifying in showing that mesquite cut in November and December and piled in loose ricks is comparatively free from damage, while that cut during the other months is seriously affected and in some cases its value is entirely destroyed.

The black locust has come into prominence on account of its value in supplying the best pins used in the construction of wooden ships. Heretofore it has not been practicable to grow this tree commercially on account of the damage to the tree and wood by the locust borer, but recent experiments have shown conclusively that it can be protected from the borer by spraying the young trees with a poisoned liquid and by a more practical method of providing a dense shade in the plantations by the use of some quick-growing shade-producing plant between the rows.

In connection with the pressing need of an increased food supply, Dr. Hopkins volunteered his services for the investigation of periodical farm practice with special reference to the application of his bioclimatic law of latitude, longitude, and altitude as a guide to the best time and period each season to do the work. This law, which has been worked out in its relation to research and practice in entomology, was believed by him, as suggested in the report of the Entomologist for the fiscal year 1917, to be equally applicable to research and practice in agriculture. Therefore much of his time during the year was devoted to a study of the application of the law to the predetermination of the safest and best time to sow winter wheat at any place in the United States where the conditions are favorable for its profitable growth.

The results of the investigations as set forth in his paper, "Periodical Events and Natural Law as Guides to Agricultural Research and Practice," published as Supplement 9 of the Monthly Weather Review, seem to have proved the practicability of the application and to have introduced a new line of attack for all problems relating to periodical farm practice, and seem to have a promise of ultimate results of special value toward increasing the food supply and the general advancement of agriculture.

TROPICAL AND SUBTROPICAL FRUIT INSECT INVESTIGATIONS.

This branch of the bureau's investigations is under the charge of the assistant chief of the bureau, Mr. C. L. Marlatt.

INVESTIGATIONS OF INSECTS AFFECTING CITRUS FRUITS IN CALIFORNIA.—Work in control of the two important mealybug enemies of citrus trees has been continued during the year and has resulted in notable success. The means now recommended by the department are

being generally recognized as practicable and efficient methods of handling infested orchards. This is particularly true in reference to the so-called citrophilus mealybug. The study of this insect was begun during the year in response to a petition from citrus associations and fruit exchanges in western San Bernardino County, where considerable alarm had been aroused by the rapid spread and great damage done by this scale insect. The citrophilus mealybug is a comparatively new pest, which started with an invasion of a few trees in 1915, but now covers an area of about 1,000 acres. A 20-acre demonstration plot has been freed from this mealybug by the combined procedure of control of the Argentine ant, spraying the trunks of the trees, and utilization of predatory natural enemies.

The important relationship of the Argentine ant to infestation by mealybugs in southern California has necessitated as a first step the control of this ant. This is accomplished by the use of poisoned ant sirup. This method of control has already been extended to upwards of 200 acres in this district, and a great expansion of this work is now in progress.

The hydrocyanic-acid gas investigations in southern California have been continued more particularly with relation to the use of liquid hydrocyanic acid—a method which on account of its convenience and efficiency bids fair to supplant the older methods of generating gas by a combination of the necessary chemicals at the moment of use. The most economical method of production of this liquefied gas is being worked out, together with field experiments to determine the best methods of use and to eliminate the risk of accidental poisoning of workmen. A Farmers' Bulletin (No. 923) has been issued, bringing down to date the standard method of fumigation hitherto used and giving full instructions for such fumigation.

CITRUS-FRUIT INSECTS IN FLORIDA.—The work of this department in the control of citrus insects has taken the form in Florida of regional orchard demonstration and is coordinated with the extension work in this State. During the year two bulletins in relation to this work have been published. One (Department Bulletin 645) is entitled "Some Reasons for Spraying to Control Insect and Mite Enemies of Citrus Trees in Florida," and the other is a Farmers' Bulletin (No. 933) giving specific directions for spraying for the control of such insects.

CONTROL OF THE FLUTED SCALE IN NEW ORLEANS.—This project was completed during the year and was discontinued June 30. It was an enterprise conducted by the city of New Orleans, the State of Louisiana, and this department in cooperation. The control of the fluted scale has been accomplished in New Orleans and neighboring places by the propagation and liberation of thousands of the natural enemy of this scale insect, the Australian ladybird, *Novius cardinalis*. Over 300 colonies of these ladybirds were liberated over an area of 40 square miles. The distribution of this beneficial ladybird has been extended to the known outlying infestations of the fluted scale in Louisiana, Mississippi, and Texas. In connection with this work some very interesting studies have been made of the fluted scale, its ladybird enemy, and particularly the symbiotic relationship between the fluted scale and the Argentine ant. The results of this work demonstrated that this ant by protecting the fluted scale from its

natural enemies enormously increased the multiplication and destructiveness of this scale insect, and that therefore one of the effective means of controlling this scale is to control the ant, as has been demonstrated similarly in the case of the mealybug in California, referred to above.

STUDIES OF GREENHOUSE INSECTS.—The spreading and penetration qualities of various contact insecticides employed in the control of insects occurring in greenhouses, with especial reference to the effect of these solutions on the plants, if applied to the soil for subterranean pests, have been under study and a considerable amount of data relative thereto assembled. The life history of the chrysanthemum aphid has been worked out and the value of water under pressure as a means of controlling the red spider determined. Several manuscripts dealing with important injurious greenhouse insects are in the course of preparation.

MEDITERRANEAN FRUIT FLY AND MELON FLY.—Under the Mediterranean fruit fly and melon fly quarantine the following fruits and vegetables are inspected and certified as a condition of their shipment from Hawaii to the mainland of the United States: Bananas of the noncooking type, pineapples, taro, and coconuts. Provision is also made for the certification for movement to the mainland of other fruits and vegetables when it can be shown to the satisfaction of the Department of Agriculture that such fruits and vegetables in the form and manner in which they will be shipped are not and can not be a means of conveying either the Mediterranean fruit fly or the melon fly. This work is a continuing work, except as to changes which may be made from time to time in the list of fruits the export of which is permitted under the direction and supervision of the Federal Horticultural Board in cooperation with this bureau.

The studies of introduced parasites have been continued during the year, and a number of very important biological facts have been determined which have added much to the knowledge of the problem of control of fruit flies by these introduced parasites, and have wide bearing on the subject of parasitic control of injurious insects. A number of technical papers on this subject have been published during the year. Notably in the case of coffee and to a certain extent also in the case of edible tropical fruits, the work of the fruit fly has been very materially checked by these introduced parasites.

EXTENSION AND DEMONSTRATION WORK.

By act of Congress, under provisions of the food-production act to stimulate agricultural production, funds were made available for this bureau to disseminate information, by demonstration or otherwise, as to methods of preventing the loss due to insects and for increasing the production of honey. This work has been placed under the supervision of Mr. J. A. Hyslop and has been carried on in cooperation with the States Relations Service and with the State agricultural colleges and experiment stations. Special field agents in entomology have been appointed and are reinforcing the State entomological forces and assisting the county agents in the several States.

This work is being carried on in the various States under definite project agreements. These projects have been formally accepted by 33 States and are in accordance with the general memorandum of understanding in force between these States and the United States Department of Agriculture.

An average of 57 specialists from the Bureau of Entomology has been maintained in the field, these men being selected with a view to their training, experience, and knowledge of field conditions in the regions in which they are to serve. Their work consists essentially in carrying out campaigns in the extension of knowledge of the methods of fighting insects, covering as effectively as possible all the important crops and domestic animals. These specialists give demonstrations to groups of farmers, live-stock men, fruit growers, and others in the preparation of spray mixtures, emulsions, and poisoned baits, and in other methods of insect control. Wherever it is possible, persons in the communities where demonstrations are being made are induced to assist in the work in order that each community may have one or more persons acquainted with the methods of assembling and applying insecticides.

Seventeen special field agents have been employed to carry on extension work in the control of insects affecting cereal and forage crops. The outstanding feature of this work has been an extensive and successful campaign for the control of grasshoppers, which early in the season promised to be extremely destructive in the upper Mississippi Valley and in Montana. The first successful campaign for the control of the "coulee cricket" in the Pacific Northwest was carried on by two of these agents in Washington and Oregon this summer. During last fall a very successful campaign for the control of the Hessian fly was carried on in the middle western wheat region, and considerable effort was directed this spring to the control of the European corn borer, a newly introduced corn pest in New England.

Three special field agents and two entomological assistants are carrying on extension work in the control of stored-product insects. The work is being confined to the Gulf States and Georgia, with the exception of the work being carried on in connection with the Quartermaster's Office for the port of New York. The work in the Southern States has been almost exclusively in the control of the black corn weevil, a pest which is conservatively estimated as annually destroying 10 per cent of the stored corn in the cotton belt. The work with the Quartermaster's Department in the port of New York has been on the control of insects which destroy both food materials and supplies held for over-seas shipment.

Twelve special field agents are carrying on extension work in the control of truck-crop insects. Owing to the nature of this work it has been found necessary to depart from the regional standpoint and place an agent more or less permanently in each State in which work is undertaken, as these agents find it necessary to correlate their work very closely with that of the county agent and the work becomes more effective the longer the field agent remains in any given State. This work last year was carried on in South Carolina, North Carolina, Louisiana, Maryland, Texas, Connecticut, New York, Massachusetts, Maine, Wisconsin, California, and Washington. The work in

the Atlantic Coast States was extremely effective in controlling a very serious outbreak of the potato aphid.

Nine special field agents are engaged in extension work in the control of deciduous-fruit insects, one agent being located in each of the following States: Washington, Oregon, Texas, Indiana, Kansas, Mississippi, Virginia, Rhode Island, and North Carolina. These agents have closely associated their work with that of the county agents, putting on demonstrations, assisting in sprayings, advising fruit growers, and giving lectures. In addition to this work, eight entomological inspectors have been employed in survey work to determine the territory covered by the recently introduced oriental peach moth.

Three agents in California and one in Florida are carrying on extension work in the control of citrus-fruit insects. The work in California has been very largely devoted to teaching methods of destruction of the Argentine ant, which incidentally will control certain of the mealybugs attacking citrus fruits.

Three agents are covering the entire lower Mississippi Valley, teaching methods of control of insects affecting poultry and cattle.

An average of six special field agents has been maintained in the field teaching modern methods in beekeeping. Work has been carried on in 34 States along this line, and the field agents have addressed nearly 25,000 beekeepers and have visited 1,198 apiaries to give personal instructions. In addition to this they have organized 84 county beekeepers' associations in the several States.

In all, the bureau's agents have held 338 conferences with county agents, extension directors, State entomologists, and others to further this work; they have put on 894 demonstrations where practical methods of insect control were actually used before growers and livestock men; they have visited 5,828 farmers to give personal advice on entomological questions, and have delivered 1,366 lectures before audiences amounting to 90,385 persons.

The bureau's representative in this work is cooperating with the States Relations Service by making an annual inspection of all States carrying on Smith-Lever fund work in entomology, with a view of improving and correlating the efforts in entomological extension work.

Another activity of this office has been the work in connection with the Bureau of Entomology's exhibits. This year an exhibit consisting of 10 screens, one screen to illustrate the activities of each of the bureau's research offices, has been prepared. These screens each contain eight bromide enlargements of the important pests, their ravages, and the methods for their control. This exhibit is part of the large interdepartmental exhibit which was displayed at 32 of the State fairs throughout the country. The motion-picture activities of the bureau have been arranged for in connection with the work on exhibits, and several films have been prepared.

WAR EMERGENCY ENTOMOLOGICAL INTELLIGENCE SERVICE.

Cooperative arrangements have been made with the entomologists of the various agricultural colleges and experiment stations, with the teachers of entomology in the other colleges and universities, with the field workers of the Forest Service, with the county agents

in the different States, with field employees of the extension service, and all other available observers, by which undue increase of any insect pest is immediately reported to this bureau, in order that knowledge of prospective outbreaks should be first centralized and then distributed to bring about the promptest and most efficacious measures. In this way the almost daily condition of the principal crops of the country in regard to injurious insects is thoroughly well known for the entire country. This information has been brought together and issued to the economic entomologists of the country in the form of manifold emergency circulars published at the end of each month. While it is impossible to estimate in any way the value of this service, there can be no doubt that it is well worth while and that it has been of a very considerable monetary value.

BEE-CULTURE INVESTIGATIONS.

This work has continued under the supervision of Dr. E. F. Phillips.

The export demand for honey has increased greatly since the beginning of the European war, indicating that honey has ceased to be a luxury in the minds of the allied peoples. During the last half of the year honey was exported to the value of perhaps \$2,000,000, about ten times the valuation of the export of honey for any year before the beginning of the war. The home demand for honey has also increased, but it is difficult to give any figures for this, as much of the honey of the country never reaches the larger centers of trade. As a result of these two demands the price of honey has risen to the highest figures recorded for many years, but during 1918 this has been influenced by the fact that there was a heavy loss of bees during the previous winter, resulting in a decrease in production in the eastern United States. This increase in price has acted as the greatest possible stimulus to the industry to increase production, the very thing which is so greatly needed if the industry is to do its share in the prosecution of the war. It is therefore safe to predict that the coming year will see the greatest effort ever made in furthering beekeeping.

The United States Food Administration has been of great help to the beekeepers in expediting shipments of honey and supplies for beekeeping, and especially in granting permits to beekeepers to buy sugar for feeding their bees where this was necessary.

The Bureau of Markets of this department has continued the issuing of the semimonthly market reports, and this has made it possible for the first time for the producer to get truthful information regarding the honey markets. This alone has been one of the chief factors making it feasible for this bureau to encourage beekeepers to increase their production. The continuation of the crop reports of the Bureau of Crop Estimates has also been of importance in this crisis in the industry.

The United States Fuel Administration was of service in permitting the chief factories for the manufacture of beekeeping supplies to run on fuelless days and in supplying one of these factories with coal at a serious time. The Post Office Department recently ruled that bees without combs may be shipped by parcel post, a ruling which materially helps in the proper distribution of bees whenever there is a serious loss in any part of the country.

Among the beekeepers of the country there has been an effort for organization for the better marketing of the crop, resulting in the forming of two large cooperative societies, both of which were assisted by the Bureau of Markets of this department. As has been indicated, there has also been a tendency for the beekeepers to organize for better education and mutual help.

The work of the bureau in bee culture during the year has therefore been chiefly a continuation of the campaign for increasing the honey crop of the country as a war measure, and to a large degree the regular investigations of the bee-culture section have either been curtailed or have been discontinued, except that on the diseases of bees, which is so important and so immediately applicable that it can not be stopped without great loss.

DEMONSTRATIONS IN BEE CULTURE.—Under the regular appropriation three men are assigned to extension work in cooperation with the regular extension service of the department and of the various States. There was also assigned to this office, from funds available under the food-production act, \$15,000, which was also applied wholly to extension work. Since this work was all conducted as one project, it is best not to attempt to separate it according to the two sources of funds.

The main feature of the extension work in beekeeping is an effort to increase the honey crop of the country as a food-production measure. The shortage of sugar has made it necessary to increase the supply of all the supplemental sweets, and none of them may be increased more economically and profitably than honey, and none of them is of more value as food. As has been pointed out in a statement from the Office of the Secretary (Circular No. 87), the amount of nectar which annually is permitted to dry up and thus go to waste far exceeds the amount of sugar of all kinds consumed by the American people, and this waste is of the highest economic importance, especially in time of war.

The first work in extension has been with those who already have bees, and no effort has been made to induce more persons to take up beekeeping. It has been shown clearly that it is unwise to encourage the keeping of bees generally, for the presence of the brood diseases, and especially the necessity of good care in winter, make beekeeping a branch of agriculture that demands specialization. However, it is realized that there must be provision for the making of beekeepers for the future, and the most promising methods seem to be through the clubs organized in connection with the extension work. In order that material may be available when it is needed, work has been begun on a program for a boys' club, and a series of special circulars is being prepared for use in connection with this program.

During the year 16 men have been employed in beekeeping extension work, and considerable additional field work has been performed by 4 men regularly employed in the Washington office. Three of these men have been called to the Army and six have resigned to take up commercial beekeeping, the present profits in beekeeping making it extremely difficult to maintain a regular force for this work. The first man appointed under the food-production act began work in November, 1917, so that most of the work has been during the last half of the fiscal year. During this time the field force has held 713

meetings of beekeepers in 34 States, reaching over 25,000 beekeepers, and, in addition, they have visited 1,198 apiaries and have given personal instruction to the owners regarding their beekeeping practices. An important part of the work has been the organization of the beekeepers in various counties into local associations for the betterment of beekeeping conditions. During the year 84 such associations were formed and plans are made for a considerable number of others to be perfected during the coming year.

An interesting and valuable phase of the extension work consists of reports on conditions pertaining to beekeeping in the various counties visited by the field staff. These are filed geographically and have already served as a valuable guide in planning the work of the field men. In time these reports, which are made incidentally as the men go about their work, will serve as a survey of the beekeeping conditions throughout the country. These reports are also furnished the extension divisions, thus making the information available to the State men engaged in the promotion of the beekeeping industry.

During the first part of the fiscal year a number of mimeograph circulars were sent to beekeepers direct, especially some urging that better care be given the bees during the winter. As the field force was enlarged this part of the work was discontinued, but it is believed that these circulars were the means of doing a great deal of good in calling to the attention of beekeepers the necessity of increasing the honey crop as a war measure. The practical advice given also served to bring about better conditions among those beekeepers who may be reached by that method, but obviously the personal contact of the field men is more effective.

In order to provide information regarding various practices of practical beekeeping two bulletins have been prepared during the year. Farmers' Bulletin 503 on comb honey has been revised and a new Farmers' Bulletin on the transferring of bees to modern hives (No. 961) has been issued. The latter bulletin will be especially applicable in certain parts of the country where modern methods have not been much practiced, but where the extension men have been at work. In view of the necessity of providing the field force with additional help and especially of the need of more practical literature on beekeeping, several additional popular bulletins are projected.

In addition to these publications there have been prepared during the year two publications showing the need of more honey during the war emergency. One of these appeared in the 1917 Yearbook of the department and another as Circular No. 87 of the Office of the Secretary. The Bureau of Crop Estimates also contributed a bulletin (Department Bulletin 685) giving statistics concerning the beekeeping industry which is of help in the same way. As a part of this phase of the work several press notices were prepared and also several papers for publication outside the department.

WINTERING OF BEES.—The investigational phases of this problem have largely been abandoned because of the press of work incident to the war, but practical observations have been continued which serve fully to substantiate the results of former years. The winter of 1917-18 was one of the worst ever recorded, and the loss of bees throughout the country was enormous, yet those colonies which had been prepared in accordance with the recommendations of the bureau

came through the winter strong in bees and were able to get the full crop during the summer. This was therefore a striking demonstration of the validity of the recommendations. The chief activity on this project has been the preparation of material for the use of the field staff on this subject, and these men have carried on a vigorous campaign to prevent future losses like that of last winter. Two additional bulletins (Farmers' Bulletins 1012 and 1014) on practical phases of the wintering problem were prepared.

DISEASES OF BEES.—This project has been continued without interruption, because of its immediate application to beekeeping practices. During the year a bulletin was issued on the control of European foulbrood (Farmers' Bulletin 975), placing for the first time a proper emphasis on the preventive measures to be taken. Another bulletin (Department Bulletin 671) was issued on the methods of laboratory diagnosis of the various diseases of bees and a paper was presented for publication on the so-called Nosema disease of adult bees. The spore-bearing organisms encountered in laboratory diagnosis have been described in a paper in the Journal of Agricultural Research.

The most important part of the work during the year was a series of field experiments on the behavior of European foulbrood in the hive during the time that it is being cleaned out by the bees. This served to throw light on the methods to be used in preventive treatment. The results of this work will be presented soon for publication. This marks a new phase in bee-disease work and promises to yield most helpful results.

WORK ON THE GIPSY MOTH AND BROWN-TAIL MOTH.

During the fiscal year ended June 30, 1918, the area along the outside border of the territory infested by the gipsy moth in the New England States has been thoroughly scouted and additional infested towns have been found, so that the total area in which the insect now occurs is 22,091 square miles, as against 20,211 square miles reported for the previous fiscal year. The increase in area by States was as follows: Maine, 938; New Hampshire, 468; Vermont, 154; Massachusetts, 112; and Connecticut, 307, making a total of 1,880. It will be noted that nearly half of the increase in infested area is in the State of Maine. This is in territory where it is extremely difficult to prevent spread of the small caterpillars, as the warm south and southwest winds tend to carry them each year beyond the infested border. The isolated colonies which have been found in previous years at Bratenahl, Ohio; Mount Kisco, N. Y.; Rutherford, N. J.; Lenox, Stockbridge, and Great Barrington, Mass., and Wallingford, Conn., have been thoroughly scouted, and the surrounding territory has been examined, but no infestation has been found. It is believed that the insect has been exterminated in these colonies.

Territory infested by the brown-tail moth has been reduced from 36,684 square miles in 1917 to 32,990 square miles in 1918.

FIELD-CONTROL WORK.—The control work in the field has been carried on in accordance with arrangements made with the officials in charge of similar work in the States concerned. The policy adopted some years ago of confining our efforts to the scouting

of towns adjoining the infested border and cleaning up the infested areas in two or three tiers of towns inside the border has been continued. Special attention in these towns has been paid to discovering and stamping out infestations on high elevations, as it is necessary to keep such areas free from small caterpillars if serious wind spread to new territory is to be prevented.

The new sprayers delivered this year are the most powerful that have yet been employed. It has been possible to spray areas on high elevations by locating the truck at the water supply and forcing the spray material in some cases through a mile of $1\frac{1}{8}$ inch hose. It has sometimes been necessary to maintain a pump pressure of 1,000 pounds in order to spray high elevations with such long leads of hose, but this has been accomplished satisfactorily and economically, when the loss of time and delay that would be experienced in hauling water such long distances is considered. Furthermore, in many cases hose lines had to be laid through woodland and rough areas where water for spraying could not be hauled.

Spraying operations were conducted in 40 towns during the month of June, as follows: New Hampshire, 22; Massachusetts, 10; Rhode Island, 1; Connecticut, 7.

PRESENT CONDITION OF THE AREA INFESTED BY THE GIPSY MOTH AND THE BROWN-TAIL MOTH.—It was apparent in the fall of 1917 that serious defoliation by the gipsy moth would result in many parts of the infested area. Conditions were particularly bad in the Cape Cod region in Massachusetts, but severe defoliation was looked for to a less extent in limited areas in other parts of the territory.

Climatic conditions during the winter were more severe than had been experienced in New England for many years. Unusually low temperatures were accompanied in many localities by abnormally low humidity. In most sections a heavy snowfall occurred about the 1st of December and in a large part of the territory the ground was covered with snow throughout the winter. This interfered seriously with field work.

The weather became very warm in May, which resulted in caterpillars hatching considerably earlier than during the two or three previous years. Later it was noted that many egg clusters which were fully exposed and which were not protected by snow or débris on the ground failed to hatch. This condition was investigated, and, while in certain sections it seems probable that egg parasites and other factors had brought this result, it is undoubtedly true that the abnormally severe weather during the winter caused a material reduction in the infestation in many localities.

The hatching of egg clusters was more perfect in the Cape Cod section in Massachusetts than in any other part of the territory, and severe defoliation resulted there during the summer. In some parts of the infested region where there was a minimum of snow protection combined with high altitudes the hatching was so deficient that spraying was not attempted. This abnormal condition, while reducing the gipsy moth infestation in some sections, may have had a similar effect in reducing the increase of some of the introduced natural enemies, particularly the egg parasites. Definite information on this phase of the problem can not be secured until later in the season.

EXPERIMENTAL WORK.—During the fall collections were made to determine the status of one of the egg parasites of the gipsy moth, *Schedius kuvanae*. The results were more satisfactory than heretofore, and it was possible to rear large numbers of this species and to colonize them in infested towns where this species had not been liberated previously. Nearly 2,000,000 specimens were released late in September and October.

In November collections were begun to determine the percentage of parasitism by *Anastatus bifasciatus*, a single-brooded egg parasite of the gipsy moth. The collections that were made in the regions where this parasite was first liberated gave the most satisfactory percentage of parasitism that had ever been secured. Material was collected for use in colonizing this insect the following spring, but, although the egg clusters were handled in the same manner in the laboratory as heretofore, the number of eggs producing live parasites was considerably less than had been secured in previous years, so that it was possible to liberate this spring less than 2,000,000 specimens. It is probable that both of these species will not survive in maximum numbers such severe winter conditions as existed during the past year. Further work later in the season will show how severe the mortality has been.

Parasitism by *Compsilura concinnata* averaged higher during 1917 than heretofore, and this species was reared from a number of native caterpillars that were not previously known to be hosts of this parasite. *Blepharipa scutellata*, a tachinid fly which parasitizes large gipsy moth caterpillars and emerges from the pupæ, was recovered in much larger numbers in the summer of 1917 than in any other year since its introduction.

A new method has been devised for breeding specimens of *Apanteles melanoscelus* for colonization, and it has worked out very satisfactorily. This species passes through two generations in the field, the first attacking the small gipsy moth caterpillars and the second destroying the nearly full-grown larvæ.

The *Calosoma* beetle has been found in limited numbers in many widely separated parts of the infested area, and is more abundant than usual in the sections that are badly infested.

There were no severe infestations by the brown-tail moth this summer, and there has been a corresponding decrease in the abundance of the imported parasites that attack this insect.

The work on diseases affecting the gipsy moth and brown-tail moth has been confined principally to an attempt to determine the abundance of the brown-tail moth fungus in the winter webs, study of the value of an unnamed fungous disease which has been found in eggs of the gipsy moth, and study and liberation of a bacterial disease which originated in Japan and attacks the gipsy moth caterpillars in the field.

Little evidence has been secured during the past two winters that the brown-tail moth fungus winters in any quantity in the webs of this insect. The investigations on the disease found in eggs of the gipsy moth have not progressed far enough to warrant conclusions as to the extent to which this disease is responsible for nonhatch of eggs. The study of the Japanese disease of the gipsy-moth caterpillars

has progressed so far that attempts have been made to colonize it in the field, but the results of these colonizations will not be apparent for another season. Data are being secured on the prevalence of the wilt disease of the gipsy moth, but it has not been as abundant or destructive to the caterpillars this year as heretofore.

Silvicultural investigations on the sample plots are being continued.

QUARANTINE WORK.—The inspection of forest and quarry products and nursery stock has been continued during the past year, although the volume of this material is not as large as that inspected heretofore. This is particularly true in connection with the shipments of nursery stock. From the number of gipsy-moth egg-clusters intercepted on material that was offered for shipment, it is evident that this work must be effectively and thoroughly performed if the insect is to be prevented from spreading to points outside the infested area.

SUMMARY.—The most severe infestation of the gipsy moth is at present in the Cape Cod district in Massachusetts. While the area infested by this insect has increased during the past year, the severity of infestation along and adjacent to the border is less severe than heretofore. The effectiveness of the imported parasites and natural enemies of both the gipsy moth and the brown-tail moth is increasing, although the severe winter conditions during the past year have been unfavorable to some of the species concerned. The area infested by the brown-tail moth has decreased materially, and the insect is not now seriously destructive except in limited localities.

Considering the area as a whole, conditions are favorable at the present time to bring about a marked decrease in the abundance and destructiveness of the gipsy moth.

REPORT OF CHIEF OF BUREAU OF BIOLOGICAL SURVEY.

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF BIOLOGICAL SURVEY,
Washington, D. C., August 29, 1918.

SIR: I have the honor to submit herewith a report on the work of the Bureau of Biological Survey for the fiscal year ended June 30, 1918.

Respectfully,

E. W. NELSON,
Chief of Bureau.

Hon. D. F. HOUSTON,
Secretary of Agriculture.

WORK OF THE BUREAU OF BIOLOGICAL SURVEY.

The work of the Bureau of Biological Survey is conducted along five principal lines: (1) Investigations of the food habits of North American birds and mammals in relation to agriculture, in charge of Dr. A. K. Fisher; (2) biological investigations with special reference to the geographical distribution of native animals and plants, in charge of E. W. Nelson; (3) supervision of national mammal and bird reservations, in charge of G. W. Field; (4) enforcement of the Lacey Act regulating the importation of birds and the interstate shipment of game, in charge of W. F. Bancroft; (5) administration of the Federal migratory bird law, in charge of George A. Lawyer.

ECONOMIC INVESTIGATIONS.

The direct relation of the field work of this bureau to the increased production and conservation of food, through the destruction of predatory animals and injurious rodents, has been thoroughly demonstrated during the year. In response to war conditions the general plans of noxious-animal control were promptly modified in order to obtain the most direct results in reducing losses of live stock due to predatory animals, and in protecting cereal and other crops from their rodent enemies, and stored food supplies and other property from contamination and destruction by house rats. During the year the increasing number of requests received by the bureau for cooperation in new areas and for an extension of operations in territory where control campaigns are already in progress showed the rapid growth of public appreciation of this work.

The need for controlling noxious mammals is evident in view of the fact that predatory animals destroy annually more than \$20,000,000 worth of live stock, mainly on the western ranges; noxious

rodents destroy not less than \$150,000,000 worth of food crops each year, and the losses through the depredations of house rats exceed a yearly total of more than \$200,000,000.

The bureau had available during the year for noxious-animal control from its regular appropriations and from emergency funds about \$445,000. State officials, organizations, and individuals expended in cooperative work, largely under the direct guidance of the Biological Survey, more than \$100,000. The State council of defense of New Mexico allotted \$25,000 from its war fund to be used to stimulate food production by cooperating with this bureau. An equal sum under similar conditions was appropriated in May by a special session of the Arizona State Legislature. Largely increased amounts for cooperative work next year are promised in many places. Appropriations of this character and large sums allotted for cooperation with the bureau by live-stock and farmers' organizations and individuals in the territory where work is being done are indications of its practical usefulness. In addition much material was contributed and many thousands of farmers and stockmen joined in the field work.

PREDATORY ANIMALS AND RABIES.

During the year the bureau had available about \$304,000 to be used in the destruction of wolves, coyotes, mountain lions, and other predatory stock-killing animals and for the suppression of rabies in wild animals. Rabies for some years has been widely prevalent in Washington, Oregon, California, Idaho, Nevada, and Utah. The general plan of organization for the predatory-animal and rabies work remains the same as during the preceding year. The Western States are divided into nine districts, each under an inspector, as follows: (1) Arizona-New Mexico, (2) California-Nevada, (3) Oregon-Washington, (4) Colorado, (5) Idaho, (6) Montana, (7) Utah, (8) Wyoming-South Dakota, (9) Texas.

Predatory animals are destroyed by a force of from 250 to 350 hunters under the direction of district inspectors. About one-fifth of these are paid from cooperative funds provided by the States or contributed by local organizations and individuals. The hunters are paid regular salaries and are permitted to receive no bounties. The skins of animals taken by Federal hunters become the property of the Government. The net proceeds already received for the skins taken during the year amount to \$78,579.45, which has been turned into the Treasury. Skins remaining unsold will probably bring the entire receipts for pelts taken during the fiscal year to approximately \$100,000.

Predatory animals are destroyed by trapping, shooting, den hunting during the breeding season, and poisoning. Poisoning campaigns were conducted on a larger scale than ever before and the results have been so satisfactory that they have received the strong support of cattle and sheep owners. Stockmen report that in the regions where poisoning campaigns have been conducted the usual severe losses from predatory animals during the lambing season have been materially reduced and, in many cases, practically eliminated. The largest poisoning operation in the West was carried on in the great sheep-growing region of southwestern Wyoming, where it covered

about one-sixth of the State. Another large area in southern Colorado was systematically poisoned with excellent effect. The experience gained in these operations indicates that with the full cooperation of local stockmen poisoning will prove a very important factor in disposing of the predatory-animal pest.

The following predatory animals were taken by hunters under the direction of this bureau, during the present year: 849 wolves, 26,241 coyotes, 85 mountain lions, 3,432 bobcats, 30 lynxes, and 41 bears. Every effort is being made to have the predatory-animal hunters kill only such bears as are known to be destructive to live stock. A small number of bears, however, unavoidably fall victim to traps set for other animals.

Since the bureau began its operations against predatory animals the skins of 70,732 have been taken and a vast number in addition have been killed by poison. Reports from various sections of the country where poisoning operations have been conducted show the finding of thousands of dead coyotes. The well-known fact that the great majority of poisoned animals are never found, coupled with the scarcity of coyotes in the poisoned areas, indicates the effectiveness of the work.

The control of rabies in the regions affected is under the supervision of the inspectors in charge of the regular predatory-animal work. Field reports indicate a continuance of this disease among wild animals, but show that the work of the bureau has been effective in limiting its spread and in suppressing it in many places. Although the disease occurs over a vast territory, the results of the work give promise of its eventual suppression without, as was at one time feared, its spreading over the entire Rocky Mountain region.

As an indication of the losses due to predatory animals it may be stated that the chairman of the State Live Stock Board of Utah estimates an annual loss in that region amounting to 500,000 sheep and 4,000,000 pounds of wool. The president of the New Mexico College of Agriculture, as a result of a survey of conditions in that State, estimates an annual loss there of 3 per cent of the cattle, or 34,000 head, and 165,000 sheep. A single wolf killed by one of the bureau hunters in southern New Mexico was reported by stock owners of that vicinity to have killed during the preceding six months 150 head of cattle valued at not less than \$5,000. In July, 1917, two male wolves were killed in Wyoming which in May had destroyed 150 sheep and 7 colts. Another pair of wolves killed near Opal, Wyo., were reported to have killed about \$4,000 worth of stock a year. Another Wyoming wolf, trapped in June, 1918, had killed 30 cattle during the spring. Exceptionally skillful hunters and trappers are detailed to capture these especially destructive animals as rapidly as they are reported, and the success in capturing them has resulted in a great addition to the meat output of the ranges.

RODENT CONTROL.

Injurious rodents, as prairie-dogs, ground squirrels, jack rabbits, and pocket gophers, mainly west of the Mississippi River, are in the aggregate enormously destructive to cultivated crops and native forage, thus directly reducing the food output from farms and lessening the carrying capacity of the range for live stock. The control

of noxious rodents, except on the public domain, is effected through cooperation with the States Relations Service of the Department of Agriculture and the extension service of State agricultural colleges. Cooperative campaigns of this kind are being conducted in North Dakota, Montana, Idaho, Washington, Oregon, Wyoming, Utah, Colorado, New Mexico, Arizona, and Virginia. This cooperation has proved to be extremely successful, as is shown by the increased number of farmers who join in the work each season. In addition to the rodent pests which abound in the more arid States of the West, several species are very destructive to certain crops and orchard trees throughout the East, where demonstration work for their control has given good results.

In order to secure accurate data as to the destruction of forage by rodents on the open range, field trial plots have been inclosed for the purpose in cooperation with the Forest Service and the Carnegie Institution of Washington. It is already apparent that important results will be secured from this investigation.

PRAIRIE-DOGS.

Measures for the destruction of prairie-dogs have been conducted by field parties operating on Government lands and by cooperative work with farmers and stockmen through the agricultural college extension services in New Mexico, Arizona, Colorado, Utah, Wyoming, Montana, and North Dakota. In all these States the campaigns have been under cooperative agreements with the State extension services, and in New Mexico the State Council of Defense has joined in the work and contributed funds to extend its scope. Farmers and stockmen are taking the greatest interest in the work as a direct method of saving crops and forage.

As an illustration of the effectiveness and economy of the methods of destroying these pests, a badly infested plot of 320 acres was chosen for a demonstration in northern Arizona. One man spent a day distributing poison over this area, at a total cost for labor and material of \$9.79. The following day 1,641 dead prairie-dogs were picked up from this tract. With the number which must have died in their holes, there can be little question that more than 2,000 prairie-dogs were destroyed in this experiment.

More than 3,500,000 acres of Government land have been practically freed from these pests.

GROUND SQUIRRELS.

Various species of ground squirrels extremely destructive to crops occur in enormous numbers over a large part of many of the Western States. The bureau has been engaged in a campaign for their control in cooperation with the State extension services in North Dakota, Montana, Idaho, and Wyoming; and introductory demonstrations leading toward similar campaigns have been made in several others of the cereal-producing States. In California there is also being conducted a campaign against these pests, with the State and county commissioners of horticulture and some county farm advisers co-operating.

The poisoned grain used in the campaigns to destroy ground squirrels on private lands is prepared under the supervision of field

representatives of the Bureau, and provided to the cooperators at cost by the local organizations. Many hundreds of tons of poisoned grain have thus been distributed on their lands by cooperating farmers. In the States of Montana, North Dakota, and Idaho alone, more than 50,000 farmers have taken part in the campaign and have provided more than \$100,000 to procure poison supplies for the purpose. Farmers in these States have also contributed labor to distribute poison upon several hundred thousand acres of Government lands adjacent to the farmed areas, in order to prevent reinfestation of their lands. This work has resulted in the practical elimination of these pests over many millions of acres, and is adding materially to the grain output in all the States where work is being conducted.

RABBITS.

The continued depredations of jack rabbits upon wheat, barley, oats, beans, alfalfa, and other growing crops and upon stacked hay has necessitated active measures for their control in many of the Western States. Wherever a market was available and conditions were favorable the campaign for the destruction of jack rabbits was directed to killing these animals by drives and trapping in order that the meat might become available for food. One small community in this way shipped over 20,000 rabbits to California markets. This feature is being developed to a more extensive utilization of the palatable meat of these animals, by systematizing their capture and marketing. In places where it was impracticable to kill them for market, poisoning operations for their destruction were conducted.

The bureau has also assisted orchardists and truck farmers, especially in the Eastern States, by advice and demonstrations concerning the means for protecting themselves from losses by cottontail rabbits.

POCKET GOPHERS.

Field parties operated on a part of the Uinta National Forest, Utah, and the Nebraska National Forest, Nebr., during the latter part of the summer, killing pocket gophers, which were abundant and destructive over valuable grazing lands. They are also extremely destructive to alfalfa fields and orchards, and to various crops. Demonstrations have been given in many places to farmers as to effective and economical methods for killing them.

NATIVE MICE AND WOOD RATS.

In cooperation with the extension service of the Virginia Agricultural College, an educational campaign was undertaken among orchardists of the State to enable them to control the serious damage caused by pine mice. Demonstrations were given in many localities throughout the infested area. Wherever the methods of the bureau were carefully carried out, orchards were effectually protected and heavy losses from these small pests were prevented. Similar assistance was also rendered in several other States which reported damage from pine, meadow, and deer mice, and from wood rats.

HOUSE RATS AND MICE.

A nation-wide educational campaign was begun, to acquaint the public with the serious drain upon the national food resources caused

by house rats and mice and the menace to health due to their presence. From data recently assembled it is estimated that the losses occasioned by house rats exceed \$200,000,000 annually in the United States.

Through bulletins, posters, magazines, and other avenues of the press, facts regarding the nature and extent of losses, and simple but effectual methods of protecting buildings, poultry, and other property from their depredations, were widely published. Demonstrations were given of methods of poisoning and trapping the animals, and plans for community organization were presented and discussed. As a result of this publicity, extended State campaigns have been undertaken in Alabama, Georgia, and Mississippi, and other States are preparing to join in the work. In addition, many local campaigns were organized.

In order to control the rat pest in the trenches and about the great Army stores one of the experts of the bureau was commissioned in the Sanitary Corps and sent to France in the spring to take charge of this work.

MOUNTAIN BEAVERS.

Investigations have been conducted to complete the study of the habits of the mountain beaver, or sewellel, a rodent living in the humid region of the northwest coast. With the development of agriculture it is becoming seriously injurious to crops, particularly to small fruits and market products. Demonstrations have been made in various localities for the control of these pests.

MOLES.

Following the demonstrations by the bureau of the market possibilities of skins of the large Townsend mole, which is extremely abundant in the northwestern coast region, the demand for its fur has steadily increased and the prices for prime skins have advanced accordingly. This animal has been a serious farm pest in western Washington, Oregon, and northern California. Successful methods of trapping it have been devised by the bureau and have been demonstrated by its representatives cooperating with the State extension services and agricultural agencies in Oregon and Washington. Great interest is being shown in the development of measures for the control of these animals, and successful boys' and girls' mole clubs have been organized. As a result many thousands of these animals have been killed and their skins marketed at prices which afford a fair profit for the work, thus paying for the cost of ridding lands of a pest.

DOMESTIC RABBITS.

The Belgian hare, or domestic rabbit, as it is commonly known, has long been a prolific producer of meat and fur in France, Belgium, Holland, England, and other parts of Europe. Under ordinary conditions the rearing of domestic rabbits for home consumption and market will give a quick and economical supply of meat, and at the same time produce fur of much value for making garments and for other manufactures. Much interest has been aroused by bulletins and other publicity matter to encourage the growing of these animals

on farms and in back yards. Boys' and girls' clubs have joined in the movement, and the number of rabbit growers in the country is rapidly increasing.

FUR-BEARING ANIMALS.

Studies of the adaptability of native fur-bearers to domestication have been continued at the Experimental Fur Farm, in Essex County, N. Y. The animals studied comprise blue foxes, minks, martens, fishers, and skunks.

Valuable results have been secured from the experiments relative to the feeding, housing, and general management of these animals. Suitable inclosures have been erected for the animals and equipment provided for preparing and preserving food.

In addition to investigational work at the Experimental Fur Farm, close touch has been maintained with fur breeders and all phases of the fur industry, from the care of animals to methods of dressing, dyeing, cleaning, and storing furs, in order to make this information available to the interested public. Investigations have been made of the basic structure and quality of various furs and of parasites and diseases affecting fur-bearers under domestication.

ECONOMIC ORNITHOLOGY.

The leading activities in economic ornithology have had to do with more or less destructive species of birds and with special cases of bird damage. Owing chiefly to the bureau's investigations of many years, the economic value of most of our native birds has been proved and recognized by protective legislation, until protection of species has advanced to a high degree and the birds have increased in numbers. In a few instances this increase has brought about changes in their economic relations and has resulted in damage to crops. It will be possible, however, under the terms of the migratory bird treaty act, to take steps for the control of certain species that at times become injurious. Similar action will be possible under State laws for certain other species. Bird protection in the United States, though entering upon a new phase, will, in general, be even more thorough than in the past, but at the same time special effort will be made to eliminate losses due to bird depredations, whether sporadic or otherwise.

FISH-EATING BIRDS IN RELATION TO THE NATIONAL FOOD SUPPLY.

At various times in the past, but especially since the United States entered the world war, fishermen have claimed that fish-eating birds greatly reduce an important national food supply, and therefore should be denied protection. To ascertain the facts the bureau has undertaken a comprehensive investigation of the whole problem. Studies are being made of the feeding habits of birds on the bird reservations, and all of the stomachs of fish-eating birds in possession of the bureau have been examined, as well as important collections loaned by the museums of the University of Michigan and the Canadian Geological Survey. Field investigations have been undertaken and will be continued to determine the habits of several

species under controversy. Results so far indicate that the proportion of commercial food fishes taken by most species of fish-eating birds is small.

DAMAGE TO RICE BY WILD DUCKS AND BLACKBIRDS.

Owing to a delay in the harvesting of rice in Arkansas in the fall of 1917, caused by unfavorable labor and weather conditions, the crop was subjected to the depredations of large numbers of wild ducks. The loss suffered by a single owner amounted to \$12,000. This was an extreme case, but a bureau investigator found that serious damage occurred very generally in the region of Stuttgart and DeWitt. The case under consideration is the first reported that has been of real importance in this region and it is thought that recurrence can be avoided by making special efforts to harvest the rice before the arrival of large numbers of ducks.

Blackbirds are complained of in Arkansas, Texas, and many other States because they feed upon grain newly sown, in the milk, and in the shock. In the aggregate far more damage is done by blackbirds than by the wild ducks. Destruction of grain, including rice, by blackbirds is exceedingly difficult to control. The bureau has sought in the past to find useful protective methods and will continue investigations and experiments to find practical means to decrease such losses.

DAMAGE TO DUCK-FEEDING GROUNDS BY SWANS.

Some damage to the feeding places of waterfowl about ducking-club holdings in Currituck Sound, N. C., and Back Bay, Va., has been done by swans, because of the increase in the numbers and especially in the tameness of these birds. Their increase has been due to the continuous protection they have received for a term of years. The birds are very wary. Under the migratory bird treaty act, their depredations can be controlled in places where it becomes necessary.

THE CROW AND THE STARLING.

A report on "The Crow in Relation to Man," has been published. Besides going into considerable detail regarding the many-sided problem of the crow, this bulletin gives suggestions for the control of these birds, which have become extremely destructive in some States.

Material for a similar report dealing with the European starling has been collected. Extensive field observations and the laboratory analysis of over 2,600 stomachs have furnished accurate information regarding the food habits of the starling in this country, and its influence on agriculture. Heretofore prejudice and the exaggeration of local grievances have been the cause of many erroneous impressions regarding the bird. The starling was found to be one of the most effective bird enemies of ground insect pests in the Eastern States. On the other hand its attacks on cherries demand that farmers be permitted to take aggressive measures against it during the ripening season of that fruit.

ECONOMIC STATUS OF OTHER BIRDS.

Examination of bird stomachs by groups was continued to the extent permitted by other assignments of the staff, which has been re-

duced in numbers by draft and enlistment. Analyses were completed for the siskin, pipits, longspurs, and red-eyed vireo, and miscellaneous examinations made for a considerable variety of other birds.

Publications issued during the year, in addition to that on the crow, were a Department Bulletin, "Food Habits of the Swallows, a Family of Valuable Native Birds," and Farmers' Bulletins, "How to Attract Birds in the Middle Atlantic States," and "How to Attract Birds in the East Central States." Five Farmers' Bulletins were revised during the year.

BIOLOGICAL INVESTIGATIONS.

Biological investigations have been conducted during the year, both in field and in laboratory, along lines essential to the administration of the Bureau. The correlated activities which depend to a greater or less extent on these investigations include the administration of the Federal migratory bird law; the enforcement of the Lacey Act, which regulates importations of, and interstate commerce in, birds and mammals; the maintenance of mammal and bird reservations; the economic relations of birds and mammals to agriculture, stock raising, forestry, and the conservation of game.

Large additions have been made to the card indexes of data concerning the distribution, abundance, and habits of the various species of North American birds and mammals, including unpublished data gathered by field parties of the Bureau and miscellaneous manuscript records from outside sources, as well as a vast amount of information gathered from publications.

DISTRIBUTION AND MIGRATION OF BIRDS.

Reports on the migration of birds have been received from nearly 400 volunteer observers located throughout the United States and many parts of Canada and Alaska. Much additional information concerning the distribution and migration of birds was gathered from published sources. Indexed files containing these data consist of considerably more than a million cards. These files are of fundamental importance in connection with the administration of the Federal migratory bird law.

BIRD COUNTS.

Reports of the fourth annual series of local counts of breeding birds made in various parts of the United States were received from about 135 observers, many of whom reported on more than one area, bringing the total number of counts of nesting birds on selected areas to about 200. These schedules include many counts made on areas previously covered, affording opportunity for comparing conditions on the same area during succeeding years. In many cases a gratifying increase in bird population has been observed. Effort is being made to enlarge the list of volunteer observers and especially to secure reports from areas representative of the various physiographic types throughout the country.

BIOLOGICAL SURVEYS.

Field work continuing the biological surveys of States was conducted in Arizona, Florida, Montana, Washington, and Wisconsin, substantial progress being made in all these States. A report on the

life zones of Wyoming was published. A report on the mammals of Panama, the result of a biological survey of the Canal Zone carried on in 1911 and 1912 in cooperation with the Smithsonian Institution, is in press. Completed reports awaiting publication include lists of the birds of New Mexico, the mammals of New Mexico, the mammals of Wyoming, the birds of Texas, and the birds of Alabama. Arrangements are in progress for the publication of some of these reports by the States interested.

BREEDING GROUNDS OF MIGRATORY WILD FOWL.

An investigation of the breeding areas of migratory wild fowl in North Dakota, which was begun in June, 1917, was continued in July. After the close of this work a similar investigation was made of Swan Lake, Minn. A report covering the results of an examination of the latter area was published by the Minnesota Department of Fish and Game. During June, 1918, the investigation of the breeding grounds of wild fowl in central North Dakota was resumed.

GAME IN NATIONAL PARKS.

At the request of the National Park Service, Department of the Interior, an investigation of the distribution, abundance, and habits of the game and other mammals of the Yellowstone and Glacier National Parks was conducted between July 1 and October 1, 1917, in cooperation with the National Park Service. Preliminary reports containing briefly annotated lists of these two areas were published by the National Park Service in their educational literature during the year. More complete reports on both of these areas are being published by the Department of the Interior.

RELATION OF RODENTS TO FORAGE AND CROP PRODUCTION.

During the spring of 1918 field investigations were begun in Arizona, Colorado, Wyoming, and North Dakota to secure correct information concerning the damage to crops and forage by prairie-dogs, jack rabbits, and other rodents. Special quadrats, fenced and unfenced, were used where these pests occurred, to be kept under close observation and reported upon at the end of the season. The results have already shown that these investigations will yield data of much practical value, especially in connection with the effort to improve the forage production of the vast stock ranges of the West.

MAMMAL AND BIRD RESERVATIONS.

The Federal big-game and bird reservations in charge of this bureau remain, as heretofore, 74 in number. Four are big-game reservations; one—Niobrara—created as a bird reservation, is used for both birds and big game; and 69 are bird reservations.

On June 30, 1918, the big-game reservations contained a total of 301 bison, 212 elk, 51 antelope, and 15 deer. The health of the game on the reservations has been excellent and the increase good.

Efforts have been made by stock growers to secure use of the bison range near Dixon, Mont., for pasturing large numbers of cattle and horses. Such use of this or any other fenced game preserve would seriously jeopardize the health and even the existence of the

game and would appear permissible only under extraordinarily serious conditions, such as have not yet developed.

In maintaining the bird reservations the bureau has continued, as during previous years, to receive the generous and active assistance of the National Association of Audubon Societies. Owing to the claim that many of the birds protected on Federal bird reservations were large destroyers of useful food fishes, the secretary of that organization has worked in cooperation with the bureau in investigating the food habits of these birds, and has visited a large number of bird reservations for the purpose of securing information to be used in a cooperative report on them. From present indications this report undoubtedly will show that there is small basis for most of the assertions which have been made as to food-fish destruction by these birds.

MAMMAL RESERVATIONS.

WINTER ELK REFUGE, JACKSON, WYOMING.—The elk came down from the mountains in their usual migration in the fall, but instead of halting among the foothills until near midwinter they proceeded in unprecedented numbers directly from the summer ranges to Jackson Hole Valley. Late in December many large herds had already collected on the refuge and in the adjacent country. Subsequent investigations showed that the foothill country ordinarily used by elk in autumn and early winter had been covered by an unusually early blanket of wet snow which had packed and become crusted until it was almost impossible for the elk to dig through to the forage. This was the reason for their early descent to the lower grounds.

During fall and early winter the weather was unusually mild, enabling the elk to obtain full benefit of the available pasturage. As a consequence, it was not necessary to begin feeding hay until February 7, three weeks later than usual. To prevent undue congestion, feeding was begun simultaneously at four points—two by the Federal warden in the refuge, and two by the State, one at Petersen's ranch to the north and the other at Leek's ranch to the south. Feeding was continued at these points until March 28, when the elk scattered in search of outside pasturage. Stormy weather during the first week of April brought many of the elk back to the feeding grounds, where feeding was resumed from April 5 to 8. The maximum number of elk at the feeding grounds at any one time was estimated to be about 10,000 head, of which about 2,500 were calves. Of the 560 tons of hay harvested on the refuge during the summer of 1917, about 440 tons were fed to the elk during the winter. The State game officials of Wyoming continued their elk-feeding operations begun in 1909 and fed about 450 tons of hay at the points named above.

The losses of elk about the various feeding grounds during the season aggregated 365 animals, of which 325 were calves. As usual, many starving calves came from the foothills to the feeding grounds in March, and a considerable number of them died. No accurate data are available concerning the losses on the winter ranges outside the refuge, but it is estimated they were far less than during the preceding year.

In order to lessen the losses on the refuge, a feeding corral containing 5 acres was constructed near the headquarters in the fall, mainly from material provided by State game officials, in order to

determine whether it was practicable to separate starving calves and weak elk from among the stronger animals in winter. Many were thus saved which otherwise would have been injured or trampled to death during the feeding operations. The experiment gave such gratifying results that still greater efforts will be made along the same lines the coming year.

As a result of a visit of representatives of the Biological Survey and of the Forest Service to the summer and winter ranges of the elk, additional lands, in the Teton Forest have been classified as chiefly valuable for elk grazing, and the grazing of cattle on certain parts of the winter range has been further restricted by regulations of the Forest Service. About $5\frac{1}{2}$ miles of drift fence to hold additional winter grazing areas for elk is being constructed on public lands adjoining the refuge as rapidly as labor conditions will permit.

Additional farming equipment has been purchased and an effort is being made to bring the yield of forage on the refuge up to a maximum in order to provide a surplus for use during unusually severe seasons. Fifty-six acres were prepared and seeded to oats and grass during the spring of 1918, and $3\frac{1}{2}$ miles of ditches and laterals for irrigation were constructed or enlarged. The work of improving the reservation will be continued as rapidly as available funds permit.

NATIONAL BISON RANGE, MONTANA.—Owing to the mild winter with little snowfall, the game on this refuge came through in fine condition. By an increase of 45 calves, 6 of which were born in July and August, 1917, the bison herd was brought up to 239 head. No adult bison died during the year, but 3 premature births occurred. Contagious abortion is reported to exist among domestic cattle in that region and it is necessary that every precaution be taken to prevent the spread of this disease to the buffalo herd.

Repeated efforts have been made to secure the use of the bison range for the pasturage of cattle and horses on account of the shortage of forage on the range in that region. To permit this would clearly endanger the existence of the game on the refuge and completely nullify the object for which it was set aside. The presence in this region of the disease mentioned above is sufficient indication of what might occur should the bison range be temporarily devoted to the use of cattle.

In the spring there were 90 elk and 34 antelope on the range, but the number of young born is still unknown. Through the cooperation of the National Park Service a nucleus herd of 6 mule deer—2 yearling bucks, 1 yearling doe, and 3 older does—were transferred from the Yellowstone National Park. As mule deer are natives of this region there is every reason to expect that they will thrive on the range.

About 4 acres favorably located were seeded to buckwheat and other cereals to supply feed for sharp-tailed grouse, which are beginning again to nest on the reservation. Large numbers of ducks, especially mallards, haunt the shallows of the river flowing through the lower parts of the reserve.

WIND CAVE NATIONAL GAME PRESERVE, SOUTH DAKOTA.—Including a calf born in August and 8 of the 9 calves born the present spring, buffalo on this preserve now number 42. One buffalo calf

was born prematurely, and a 15-year-old cow and calf of this season died during the year. The preserve contains 71 elk, with further returns to be obtained concerning the young born.

The antelope herd numbers 15, of which 5 are young born during the past spring. During the summer of 1917 there were 23 antelope on this preserve, but 13 of these were killed in the fall and winter by coyotes, which had gained access to the inclosure. The warden tried for some time to trap and poison these animals, but without success. Finally a Government predatory animal hunter was stationed on the preserve and caught 19 coyotes, most of them outside the fence. The holes under the fence through which the coyotes obtained access have been closed and every effort made to increase the coyote-proof character of the inclosure. Since 1913, when the preserve was stocked with big game, 34 coyotes have been caught in this vicinity, 14 of them inside the preserve fence. The increase of 5 fawns from the 10 surviving members of the herd is encouraging and extraordinary precautions will be taken to protect them during the coming winter.

A fire started by an electric storm broke out during July, but, with the help of rangers from the Harney Forest, was extinguished within two or three days without doing material damage. On June 23 a cloudburst and flood washed out the crossings and broke the fence in five places, each break being about 7 rods in width. Prompt repairs by the warden prevented the escape of any of the game animals.

During the last park season, visitors to Wind Cave numbered 16,742, many of the visitors coming solely to see the animals, a never-ending source of interest to the public.

SULLYS HILL GAME PRESERVE, NORTH DAKOTA.—Early this fiscal year a 5-room frame cottage was completed, together with a frame barn, as headquarters for the resident warden. Warden service has been maintained throughout the year.

There are now on the preserve 14 elk and 5 deer in good condition. Negotiations have been continued to secure a small herd of bison for this preserve, but various difficulties have occurred from time to time to prevent this.

The preserve is a favorite picnic ground for several thousands of people who go there for an outing each summer. A small additional expenditure to increase the size of this preserve and to add some improvements would greatly increase its attractiveness and usefulness to the public.

NIORARA RESERVATION, NEBRASKA.—The bison herd on this reservation now numbers 21. There are 37 adult elk, but the number of calves born during the spring is still unknown. Two mule deer also are on the reservation, making a total of 60 big-game animals.

An additional pasture of 200 acres to accommodate the big game on the reservation has been inclosed by a substantial fence, the original 200-acre pasture being overstocked. Steps are also being taken toward the construction of several miles of fencing against cattle on the southern part of the reservation to allow a growth of better cover for encouraging the nesting of sharp-tailed and pinnated grouse.

BIRD RESERVATIONS.

The 69 Federal bird reservations continue to furnish attractive feeding, breeding, and resting places for many species of birds useful on account of their value either for food, as insect destroyers, or for their beauty. The value of well-chosen bird reservations as an asset to the country is becoming more and more appreciated. Among the most notable of the Federal reservations are those at Klamath and Malheur Lakes, in Oregon, and Big Lake, in Arkansas. As funds become available, it will be possible to develop some of these reservations and greatly increase their usefulness.

Steps have been taken by interested parties to drain the water from both the Klamath and Malheur reservations, to make the land available for agricultural use. The resulting gain is more than doubtful, while the loss would be a most serious one, not only to Oregon but also to the other Pacific Coast States, owing to the fact that these two bodies of water are the greatest inland breeding resorts for wild fowl remaining on the west coast. To destroy them would have a seriously detrimental effect on the future of the wild fowl of this region.

The continual progress of draining operations, whereby water is drawn from marshy tracts and shallow lakes and the land is devoted to agriculture, is rapidly cutting down the remaining feeding grounds for wild fowl. For this reason every effort should be made to retain a few specially desirable natural resorts for wild fowl in various parts of the country. Failure to do this will result in a decrease of our wild-fowl resources, which may occasion far more loss than the agricultural value from these tracts will offset.

In Florida, during the past year, a movement was on foot against the brown pelicans on the ground that they were destroying food fishes, and that for that reason during this time of national stress they should be killed. As a result of the agitation a night raid was made on the Pelican Island Reservation during the spring and about 400 young birds were wantonly killed. Investigation proved that the charges against the pelicans had little real basis in fact, since the fishes eaten by these birds are not of the species classed as food fishes.

An inspection of Passage Key Reservation, at the mouth of Tampa Bay, showed that this valuable bird resort is being rapidly cut away by sea currents. The erosion has reduced the island until during storms the sea is driven across most of it, and there is little doubt that within a comparatively short time it will be washed away. The size of East Timbalier Island also is being much reduced by erosion.

On the other Florida bird reservations visited, including those at Charlotte Harbor and the Indian Key Reservation, near the mouth of Tampa Bay, birds were nesting in large numbers and there was no evidence that they were being molested.

The rapid decrease in numbers of the sage hen, the largest and one of the most interesting of the North American grouse, appears to call for the establishment of preserves to safeguard it in several parts of its range, notably in eastern Oregon and possibly in Wyoming, Utah, or Nevada.

No warden service has been possible on the Hawaiian Islands Reservation, but from information received from time to time from

volunteer observers, apparently no further poaching has taken place on that remote bird breeding ground.

INTERSTATE COMMERCE IN GAME.

ILLEGAL SHIPMENTS.

For the enforcement of the Lacey Act, regulating interstate shipments of game, five inspectors were employed, each in charge of one of the five districts into which the country is divided; one of these resigned in May. As a result of the activities of the inspectors, coupled with the ready cooperation of State game officials, illegal shipments of game are rapidly lessening.

During the present year special attention has been given to the illegal shipment of quail in the Middle Western States, and 19 cases were reported for prosecution. Only 4 cases of the unlawful shipment of wild ducks were reported, the smallest number for any year since the passage of the Lacey Act. Special effort has also been made to stop illegal shipments of beaver skins from States having continuous closed seasons on these animals, and to suppress illegal shipments of skins of other fur-bearers.

Thirty-seven violations of the Lacey Act (secs. 242, 243, and 244 of the Penal Code of the United States) were reported to the solicitor during the year. Twenty-two cases were based on illegal interstate shipments of wild game, 10 on knowingly receiving such illegal shipments, and 5 on improper markings of shipments. Six additional cases, lacking only the necessary affidavits to complete them, are in course of preparation, making a total of 43 cases.

The traffic in violation of the Lacey Act included quail, prairie chickens, wild ducks, English pheasants, partridges (ruffed grouse), deer, squirrels, and beaver skins, violations taking place in the following States: Colorado (1), Illinois (10), Indiana (1), Kansas (1), Maine (2), Maryland (2), Massachusetts (2), Missouri (3), Montana (1), New Hampshire (1), New Jersey (3), North Dakota (1), Oregon (1), Pennsylvania (3), South Dakota (1), Tennessee (1), Utah (1), Virginia (1), and Washington (1).

Investigations of 25 violations of the Lacey Act in 13 States and the District of Columbia were not reported for prosecution for various reasons, as follows: Prosecutions already made and adequate fines imposed in State courts for shipping in violation of State laws; circumstances, financial and otherwise, of violator; innocent violation of law and mitigating circumstances in connection therewith; recommendations made by State and local game officials; and death of violator.

Thirty cases, including a few reported in previous fiscal years, were disposed of by the courts, resulting, in all but one case, in the imposition of fines ranging from \$5 and costs to \$200 and costs. The total amount of fines imposed was \$2,873.

IMPORTATION OF BIRDS AND MAMMALS.

War conditions and the resulting restrictions on foreign shipping have had a marked effect on the importation of birds and mammals during the year. On February 14, 1918, the President issued a

proclamation requiring a license to import certain articles from foreign countries, and on March 23 the War Trade Board through its Bureau of Imports published a list of restricted imports, among which were live animals, except those to be used for scientific and breeding purposes. Under these conditions few shipments have been received from England, and importers have had to rely almost entirely on South America and the Orient for birds and mammals for exhibition and propagation. Notwithstanding the restrictions, importations from England have not ceased entirely, as shown by the arrival of several miscellaneous consignments during the first half of the fiscal year and one during the spring.

The number of permits issued during the year decreased 25 per cent, from 413 in 1917 to about 300 in 1918, and the number of inspections from 112 to 76. More than 25 per cent of the permits issued were for the entry of foxes from Canada, the total number entered under these authorizations being 391. Among the birds imported were 6,232 game birds, 10,000 canaries, and 51,302 other nongame birds. At Honolulu only 13 permits were issued, for the entry of 176 birds, chiefly pheasants. So far as known, no prohibited species were brought in during the year.

The total number of birds and mammals imported included 1,933 mammals, as compared with 4,135 in 1917, and 67,933 birds, as compared with 97,993 in 1917. The importation of game birds and canaries reached the lowest point since 1900. Nearly 85 per cent of the game birds were quail from Mexico, and of the 1,027 others only 150 were pheasants. The total number of canaries imported during the year was less than the average importation for a 10-day period in 1913, the year before the war, and the time of maximum entries. The canaries imported were partly English and partly Chinese; very few were German singers, which formerly made up a very large proportion of the shipments.

The shipments of miscellaneous nongame birds included a number of rare species and also species imported for the first time. Among the most important entries were a large consignment from Australia, a small but important shipment from South Africa, and several shipments from Colombia, Venezuela, and Brazil. Among the rarer birds of special interest may be mentioned: Two species of birds of paradise, including two specimens of the Count Raggi bird of paradise (*Paradisea raggiana*) and one lesser bird of paradise (*P. minor*), from New Guinea; two regent birds (*Sericulus chrysocephalus*); two tawny frogmouths (*Podargus strigoides*) from Australia; nearly 1,500 of the beautiful Lady Gould finch (*Poephila mirabilis* and *P. gouldiae*) from northwestern Australia; 155 little painted quail (*Excalfactoria lineata*) from the Philippines; and two white-crested touraco (*Turacus corythaix*) and two-horned guinea fowl (*Numida coronata*) from Africa. Many rare birds were imported from South America, including, among others, an imperial parrot (*Amazona imperialis*) and a Brazilian hawk-headed parrot (*Derophtus accipitrinus fuscifrons*). Other importations of the year comprised an echidna, the first since 1913, and several mammals brought in for the first time, among which were a brown hyena from South Africa and several species of kangaroos from Australia.

IMPORTATION OF QUAIL FROM MEXICO.

The joint regulations governing the importation of quail from Mexico, issued by the Treasury Department and the Department of Agriculture under date of November 13, 1916, were in full force and effect the past season, the entry of quail being permitted from February 15 to April 10, inclusive, and on March 8, 1918, Laredo, Tex., was designated as a port of entry in addition to Eagle Pass, Tex., and New York City. Cooperation was continued with the Bureau of Animal Industry in having a thorough inspection of the birds made during the ten days' quarantine.

The first permit was issued February 20 and the last, April 4. The number of quail for which permits were issued was 10,500, and the number released from quarantine only 5,205, as compared with permits issued for 42,973, and the release of 32,814 in 1917.

The notably large decrease in the number of quail actually imported during the past year is accounted for by the scarcity of birds in northern Mexico due to drought, and the refusal of large ranch owners to permit the trapping of quail on property owned and controlled by them. Also it is evident that State game officials were reluctant the past year to purchase Mexican quail for propagation because of the severe losses of birds imported during the season of 1917.

Of the 5,205 birds actually released from quarantine only 16 were found dead during the 10-days' quarantine period, and no case of quail disease was discovered. So far as reports received by the department indicate, there were few losses of birds in shipping. The change of dates for the importation of Mexican quail—beginning at a later period, February 15, instead of in the fall, as in 1916—has proved beneficial by preventing the birds from reaching the northern States during severe winter weather.

INFORMATION CONCERNING GAME LAWS.

The regular annual publications, including a directory of officials and organizations concerned with the protection of birds and game, the eighteenth annual summary of game laws (prepared on a different plan from those heretofore issued), a general poster showing open seasons for game in the United States and Canada, and a local poster showing open seasons for North Carolina, where many local laws apply to particular counties, were issued and widely distributed. State game laws have been carded and indexed as fast as received, memoranda of the more important changes being specially noted.

FEDERAL MIGRATORY BIRD LAW.

Owing to the prevention of spring shooting during the last few years, under the Federal migratory bird law, a great increase in migratory wild fowl has been reported throughout practically the entire United States. The reports state that more birds were killed during the fall of 1917 than in any similar season for many years. With the need of increasing food resources, this increase in game

birds, as a result of a Federal conservation law, was a practical and opportune return. Continued protection of our wild fowl during the spring will unquestionably continue to increase the returns in food and sport from this source each year.

For administrative purposes under the migratory bird law the United States is divided into 13 districts, under the supervision of 12 inspectors, who, with the assistance of 182 Federal wardens, enforce the regulations in the various States. During the year the commissions of 47 Federal wardens were terminated and 49 new wardens were appointed.

The inspectors and Federal wardens reported 313 violations of the regulations, which with those of previous years make a total of 1,132 cases on file. All but 29 of these cases, which have been disposed of in court, have been withheld pending the decision of the United States Supreme Court in the case of the *United States v. Shauver*, involving the constitutionality of the law. Defects in the law, particularly in that it did not make the possession of birds during the closed season unlawful, and did not confer on inspectors and wardens the power of arrest and search, made it possible for many violators to escape. A further difficulty in enforcement was encountered in the limited number of inspectors, each with an unduly large district. Reports, however, show that violations were more sporadic and fewer birds were killed unlawfully than in previous years.

Voluminous information has been received from State game commissions and others showing that there is an ever-increasing number of waterfowl and shorebirds in most of the States; furthermore, that wild fowl have become unusually tame in spring because they are not molested at that season; and that many thousands are breeding in localities where they had not nested for many years.

The consensus of opinion attributes these greatly improved conditions to the general observance of the Federal prohibition against spring shooting which has been brought about through the good will of sportsmen and by the increased activities of this bureau, with closer cooperation of State game authorities.

The friendly attitude of the State game commissions toward the Federal migratory bird law has been shown in many ways, particularly in their initiative whereby the State and Federal regulations have been brought into harmony. Twenty-three States now have laws making the open seasons on migratory wild fowl similar to those under the Federal regulations. Amendments of the regulations were promulgated October 15, 1917, which assisted in unifying Federal and State game laws, thus simplifying their administration.

A bill to give effect to the treaty between the United States and Great Britain for the protection of birds which migrate between this country and Canada passed the Senate July 30, 1917. The Senate bill, with amendments, passed the House June 6, 1918, and was then referred to a conference committee. The conference report was adopted by the House June 28, and by the Senate June 29, and the bill was signed by the President and became effective July 3, 1918.

Nation-wide interest was manifested in the passage of this legislation, which was secured through the united efforts of State game commissions, sportsmen, farmers, and others interested in the conservation of wild life. The new law contains many excellent provisions necessary for its effective enforcement, and it will be possible to obtain much more satisfactory results under it than have been possible under the original migratory bird law. Canada has already passed an enabling act and promulgated regulations for enforcing the terms of the treaty.



REPORT OF THE CHIEF OF THE DIVISION OF ACCOUNTS AND DISBURSEMENTS.

UNITED STATES DEPARTMENT OF AGRICULTURE,
DIVISION OF ACCOUNTS AND DISBURSEMENTS,
Washington, D. C., October 15, 1918.

SIR: I have the honor to submit herewith a report of the work of the Division of Accounts and Disbursements for the fiscal year ended June 30, 1918.

Respectfully,

A. ZAPPONE,
Chief of Division.

Hon. D. F. HOUSTON,
Secretary of Agriculture.

CHARACTER OF WORK.

The chief of the division and disbursing clerk is charged by the Secretary of Agriculture with the duty of preparing all requisitions for the advance of public funds from the appropriations for the Department of Agriculture to the disbursing clerk and to special disbursing agents charged with the disbursement of public funds; the keeping of accounts and appropriations ledgers relating to the advance and disbursement of all items of appropriations; and the examination and payment of all vouchers and pay rolls submitted from the various offices, bureaus, and services of the department. He performs such other duties as may be prescribed by the Secretary.

WORK OF THE YEAR.

APPROPRIATIONS, EXPENDITURES, ETC.

To carry on the work of the Department of Agriculture during the fiscal year ended June 30, 1918, Congress appropriated \$25,929,113 in the agricultural act for that fiscal year, in addition to which permanent annual appropriations, special appropriations, deficiency appropriations, and the appropriation for printing and binding were available, amounting to \$46,430,433.60, making a total of \$72,359,546.60, of which sum \$33,786,487.30 was disbursed prior to the close of the year, leaving a balance at the end thereof of \$38,573,059.30, which is nearly all covered by outstanding liabilities.

Supplemental accounts for the year 1916 were also paid, amounting to \$2,727,648.75.

On June 30, 1918, the unexpended balances for the year 1916, amounting to \$435,114.21, were finally covered into the Treasury to the "Surplus fund."

There were received, examined, and paid by this office 161,501 vouchers and pay rolls, which required the issuance of 283,203 checks on the Treasurer of the United States.

There were also sent to the Treasury Department for payment 7,866 accounts.

LOST CHECKS.

During the year 160 checks were lost in transit through the mails or by the payees, and were duplicated by this office.

PUBLIC MONEYS RECEIVED FROM VARIOUS SOURCES.

There were received from various sources and deposited in the Treasury to the credit of the proper funds the following sums:

Miscellaneous expenses:

Telegrams over Government lines.....	\$4,763.30
Sale of cotton standards.....	2,360.60
Cost of cotton-futures disputes.....	1,227.70
Sale of loose cotton.....	33,578.66
Cost of grain standards appeals.....	1,458.48
Sale of photo prints and lantern slides.....	675.58
Sale of hearings.....	58.10
Receipts on account of war-tax collections.....	305.82
Sale of card indexes.....	26.31
Sale of other miscellaneous Government property.....	62,031.60
Sale of seeds by the Bureau of Plant Industry.....	1,490,173.96
Sales of products, agricultural station, Hawaii.....	147.35
Sales of products, agricultural station, Alaska.....	1,211.20
Sales of products, agricultural station, Porto Rico.....	1,224.33
Sales of products, agricultural station, Guam.....	242.97
Sales of nitrate of soda to farmers.....	3,628,726.41

Repayments to appropriations:

Mileage, mileage books, etc.....	14,327.30
Transfers from other departments for work done and supplies furnished.....	58,037.62

Total..... 5,300,577.29

STATEMENT OF APPROPRIATIONS, DISBURSEMENTS, AND UNEXPENDED BALANCES FOR THE UNITED STATES DEPARTMENT OF AGRICULTURE.

[Fiscal years 1839 to 1904, inclusive.]

Fiscal year.	Amount appropriated.	Amount disbursed.	Amount unexpended.	Fiscal year.	Amount appropriated.	Amount disbursed.	Amount unexpended.
1839..	\$1,000.00	\$1,000.00		1872..	\$197,070.00	\$195,977.25	\$1,092.75
1840..				1873..	202,440.00	201,321.22	1,118.78
1841..				1874..	257,690.00	233,765.78	23,924.22
1842..	1,000.00	1,000.00		1875..	337,380.00	321,079.83	16,300.17
1843..				1876..	249,120.00	198,843.64	50,276.36
1844..	2,000.00	2,000.00		1877..	194,686.96	188,206.19	6,480.77
1845..	2,000.00	2,000.00		1878..	198,640.00	197,634.94	1,005.06
1846..	3,000.00	3,000.00		1879..	206,400.00	206,360.00	40.00
1847..	3,000.00	3,000.00		1880..	199,500.00	198,361.72	1,138.28
1848..	4,500.00	4,500.00		1881..	275,460.31	267,608.84	7,851.47
1849..	3,500.00	3,500.00		1882..	363,011.05	354,482.39	8,528.66
1850..	5,500.00	5,500.00		1883..	456,396.11	438,941.72	17,454.39
1851..	5,500.00	5,500.00		1884..	416,641.10	413,618.09	3,023.04
1852..	5,000.00	5,000.00		1885..	655,930.25	558,934.89	96,995.36
1853..	5,000.00	5,000.00		1886..	677,973.22	519,196.11	158,777.11
1854..	10,000.00	10,000.00		1887..	657,641.81	628,287.14	29,354.67
1855..	50,000.00	50,000.00		1888..	1,027,219.06	1,011,282.62	15,936.44
1856..	30,000.00	30,000.00		1889..	1,134,480.60	1,033,590.22	100,890.38
1857..	75,000.00	75,000.00		1890..	1,170,139.11	971,823.62	198,315.49
1858..	63,500.00	63,157.25	\$342.75	1891..	1,372,049.21	1,266,277.36	105,771.85
1859..	60,000.00	60,000.00		1892..	2,303,655.75	2,253,262.29	50,393.46
1860..	40,000.00	40,000.00		1893..	2,540,060.72	2,355,430.25	184,630.47
1861..	60,000.00	60,000.00		1894..	2,603,855.58	1,977,469.28	626,386.30
1862..	64,000.00	63,704.21	295.79	1895..	2,506,915.30	2,021,030.38	485,884.62
1863..	80,000.00	80,000.00		1896..	2,584,013.22	2,094,916.42	489,096.80
1864..	199,770.00	189,270.00	10,500.00	1897..	2,448,763.53	2,348,512.98	100,250.55
1865..	112,304.05	112,196.55	107.50	1898..	2,467,902.00	2,425,510.44	42,391.56
1866..	167,787.82	167,787.82		1899..	2,829,702.00	2,827,795.65	28,906.35
1867..	199,100.00	199,100.00		1900..	3,006,022.00	2,947,603.42	58,418.58
1868..	279,920.00	277,094.34	1,925.66	1901..	3,304,265.97	3,239,137.39	65,128.58
1869..	172,593.00	172,593.00		1902..	3,922,780.51	3,902,675.79	20,104.72
1870..	156,440.00	151,596.93	4,843.07	1903..	5,015,846.00	4,734,230.84	281,615.16
1871..	188,180.00	186,876.81	1,303.19	1904..	5,025,024.01	4,969,311.64	55,712.37

STATEMENT OF APPROPRIATIONS, DISBURSEMENTS, AND UNEXPENDED BALANCES FOR THE UNITED STATES DEPARTMENT OF AGRICULTURE.

[Fiscal years 1905 to 1918, inclusive.]

Fiscal year.	Agricultural appropriation act.			Other acts.			Total.		
	Appropriated.	Disbursed.	Unexpended.	Permanent annual appropriations, deficiency acts, special acts, and printing and binding under the sundry civil act.	Disbursed.	Unexpended.	Appropriated.	Disbursed.	Unexpended.
1905.	\$5,902,040.00	\$5,826,365.63	\$75,674.37	\$1,207,642.62	\$1,207,642.62	.....	\$7,109,682.62	\$7,034,008.25	\$75,674.37
1906.	6,882,690.00	6,686,510.02	196,179.98	1,955,219.96	1,955,219.96	.....	8,837,909.96	8,641,729.98	196,179.98
1907.	9,932,940.00	9,568,845.02	364,094.98	2,310,491.66	2,310,491.66	.....	13,079,523.98	11,879,336.68	1,200,187.30
1908.	9,447,290.00	9,279,955.36	167,334.64	3,146,583.98	3,315,546.89	\$836,092.32	13,037,802.62	12,365,502.25	442,300.37
1909.	11,672,106.00	11,478,666.40	193,439.60	3,590,512.62	4,368,328.79	274,965.73	16,153,534.74	15,847,195.19	306,339.55
1910.	12,995,036.00	12,647,918.27	347,117.73	4,481,428.74	4,056,552.21	112,899.95	17,115,410.35	16,704,470.48	410,939.87
1911.	13,487,636.00	13,184,652.22	302,983.78	4,120,374.35	7,240,115.70	63,822.14	20,888,449.28	20,424,767.92	463,681.36
1912.	16,900,016.00	15,530,970.55	1,369,045.45	7,400,813.28	5,502,285.11	160,697.58	22,402,301.11	20,985,299.39	1,417,001.72
1913.	16,651,496.00	16,005,448.40	646,047.60	5,502,285.11	8,481,328.50	47,936.27	25,177,164.68	24,486,776.90	690,387.78
1914.	17,986,945.00	17,297,761.46	689,183.54	8,525,683.68	6,393,232.94	44,340.18	24,449,824.37	23,690,994.40	758,829.97
1915.	19,805,832.00	19,408,375.18	457,456.82	6,462,879.37	6,937,656.99	336,945.56	26,840,434.55	26,046,032.17	794,402.38
1916.	22,971,782.00	20,388,732.68	2,583,049.32	6,974,602.55	1,931,426.17	4,116,495.81	29,019,703.98	22,320,158.85	6,699,545.13
1917.	24,948,852.00	21,695,357.38	3,253,494.62	12,240,000.00	6,360,914.65	5,879,085.35	37,188,552.00	28,056,272.03	9,132,579.97
1918.	25,923,113.00	16,909,351.67	9,019,761.33	46,430,433.60	16,877,135.63	29,553,297.97	72,359,546.60	33,786,487.30	38,573,059.30

REPORT OF THE CHIEF OF THE DIVISION OF PUBLICATIONS.

UNITED STATES DEPARTMENT OF AGRICULTURE,
DIVISION OF PUBLICATIONS,
Washington, D. C., July 12, 1918.

SIR: I have the honor to submit herewith a report on the operations of the Division of Publications for the fiscal year ended June 30, 1918.

Respectfully,

JOS. A. ARNOLD,
Chief of Division.

Hon. D. F. HOUSTON,
Secretary of Agriculture.

SUMMARY OF PUBLICATIONS.

The publication work of the department exceeded in magnitude and variety of documents that of any previous year. Including the work charged to a special fund for emergency printing, provided in the food production act, 2,205 publications of all kinds were issued, as follows: 821 bulletins, orders, reports, separates, etc., of which the editions aggregated 36,738,494 copies; 164 periodicals, 11,394,700 copies; 52 leaflets, 22,555,000 copies; 4 pamphlets, 513,000 copies; 21 circulars and folders, 3,347,000 copies; 24 posters, 1,843,500 copies; 1,119 publications, bulletins, maps, etc., of the Weather Bureau, 920,205 copies.

The total editions of new documents of all kinds aggregated 77,311,899 copies. Of the 341 publications reprinted to supply the demand, the editions amounted to 19,947,500 copies. The total number of copies of new publications and reprints for the year, therefore, was 97,259,399.

The number of new Department Bulletins contributed by the various bureaus, divisions, and offices was 133, of which 846,500 copies were ordered.

The 11 Department Bulletins reprinted aggregated 45,000 copies.

There were 130 new Farmers' Bulletins as compared with 84 last year, of which the editions ordered amounted to 10,815,000 copies.

Reprints were ordered of 236 Farmers' Bulletins heretofore issued, aggregating 10,884,000 copies. Thus the number of Farmers' Bulletins ordered during the year reached the total of 21,699,000 copies.

Of the emergency leaflets, pamphlets, posters, folders, etc., used in connection with the department's campaign to increase food production, 28,258,500 copies were ordered. These in part were shipped

in bulk directly from the plants in which they were printed to the distributing points. The publications of the Weather Bureau were distributed by that office.

The number of printed documents of all classes distributed by the Division of Publications was 99,222,321.

ALLOTMENTS AND EXPENDITURES.

The regular appropriation for printing and binding was \$650,000, from which the expenditures were \$649,917.56, leaving a balance of \$82.44.

The number of requisitions on the Public Printer was 3,843, as compared with 4,140 for the preceding year.

Of the regular appropriation of \$650,000, not exceeding \$200,000 was allotted by law for printing Farmers' Bulletins, and not exceeding \$47,000 for the use of the Weather Bureau.

SUMMARY OF EXPENDITURES FROM THE REGULAR FUND FOR PRINTING AND BINDING.

Expenditures chargeable to the regular appropriation for printing and binding aggregated \$649,917.56. The following statement shows the amounts expended from this appropriation, arranged by classes of printing and by bureaus.

Expenditures from the regular fund for printing and binding for the fiscal year ended June 30, 1918.

ARRANGED BY CLASSES OF PRINTING, AND SHOWING FOR EACH CLASS THE PER CENT OF TOTAL.

Class.	Amount.	Per cent.
Farmers' Bulletins.....	\$198,840.44	30.59
Department bulletins and unnumbered publications.....	110,735.38	17.04
Periodical publications.....	108,666.81	16.72
Congressional publications.....	26,555.77	4.09
Compilations of laws, manuals, fiscal regulations, etc.....	2,661.16	.41
Miscellaneous administrative circulars, orders, decisions, etc.....	44,297.42	6.82
Separates and unnumbered pamphlets.....	22,345.42	3.44
Posters, placards, labels, maps, etc.....	13,100.20	2.02
Binding.....	20,225.76	3.11
Index cards.....	19,945.85	3.07
Blank forms.....	51,425.84	7.91
Blank books.....	16,533.09	2.54
Letterheads.....	14,521.23	2.23
Envelopes.....	63.19	.01
Total.....	649,917.56	100

Expenditures from the regular fund for printing and binding for the fiscal year ended June 30, 1918—Continued.

ARRANGED BY BUREAUS, AND SHOWING ESTIMATED COST OF WORK ORDERED BUT NOT COMPLETED.

Bureau.	Expenditures.			Estimates on work carried to 1919.	Total of expenditures and estimates.
	Job work and binding.	Publications.	Total expenditures.		
Bureaus:					
Division of Accounts and Disbursements.....	\$1,550.03	\$15.68	\$1,565.71	\$145.02	\$1,710.73
Bureau of Animal Industry.....	9,168.10	16,295.58	25,463.68	1,313.43	26,777.11
Bureau of Biological Survey.....	1,608.35	3,647.43	5,255.78	1,265.53	6,521.31
Bureau of Chemistry.....	5,176.28	15,977.16	21,153.44	4,165.83	25,319.27
Bureau of Crop Estimates.....	14,194.20	21,189.89	35,384.09	4,221.80	39,605.89
Bureau of Entomology.....	1,820.96	12,386.25	14,207.21	1,041.39	15,248.60
Office of Farm Management.....	517.53	6,437.36	6,954.89	546.05	7,500.94
Federal Horticultural Board.....	709.43	1,507.02	2,216.45	159.07	2,375.52
Forest Service.....	13,892.12	12,454.11	26,346.23	6,091.21	32,437.44
Insecticide and Fungicide Board.....	173.91	1,532.84	1,706.75	26.88	1,733.63
Library.....	12,018.30	50.08	12,068.38	1,480.07	13,548.45
Bureau of Markets.....	10,861.24	9,207.25	20,068.49	6,508.04	26,576.53
Bureau of Plant Industry.....	6,362.07	35,129.85	41,491.92	11,308.13	52,800.05
Office of Public Roads and Rural Engineering.....	1,052.93	4,943.93	5,996.86	1,081.16	7,078.02
Division of Publications.....	1,980.30	13,951.24	15,931.54	256.96	16,188.50
Office of the Secretary.....	14,628.65	73,032.02	87,660.67	37,929.81	125,590.48
Bureau of Soils.....	709.54	7,928.26	8,637.80	30,792.97	39,430.77
Solicitor.....	195.23	508.73	703.96	7.81	711.77
States Relations Service.....	19,998.33	52,401.93	72,400.26	12,511.43	84,911.69
Weather Bureau.....	16,056.82	21,940.57	37,997.39	3,818.00	41,815.39
Projects:					
Agricultural Atlas.....	3,140.84	.....	3,140.84	1,151.84	4,292.68
Report on the lumber industry.....	.....	4,724.78	4,724.78	.....	4,724.78
Total (except Farmers' Bulletins)...	135,815.16	315,261.96	451,077.12	125,882.43	576,959.55
Farmers' Bulletins ¹.....	.....	.....	198,840.44	33,278.38	232,118.82
Total (including Farmers' Bulletins).....	135,815.16	315,261.96	649,917.56	159,160.81	809,078.37

¹ Farmers' Bureaus given in total only, because charged to a special allotment of the regular printing fund, though these bulletins are contributed by various bureaus.

The estimated cost of work not completed, therefore carried forward to the present fiscal year, is shown also. The cost of completing this work carried over is estimated at \$159,160.81. This unusually large "carry-over" was due partly to congestion at the Government Printing Office and partly to insufficiency of the printing appropriation to meet the unusual demands for printing under war conditions.

DETAILED STATEMENT OF EXPENDITURES FROM THE REGULAR FUND FOR PRINTING AND BINDING, BY CLASSES OF WORK, FOR EACH BUREAU.

The following statement shows in detail the expenditures for printing and binding for the various bureaus, divisions, and offices, chargeable against the regular appropriation of \$650,000. The classes of work and the amount or number of copies are given.

The expenditures include the final charges for work ordered in the fiscal year 1917 but not completed in that year, and the first charges on work ordered in the fiscal year 1918 and completed only in part, the final charges for which will be paid from the appropriation for 1919.

The number of copies given does not in every case represent the number actually received. The number actually received and the number distributed are given in connection with the distribution of documents, under the head of Document Section.

Expenditures from the regular fund for printing and binding, with the number of copies (arranged by classes of printing and by bureaus, divisions, and offices), for the fiscal year ended June 30, 1918.

Bureau or project.	Total.		Farmers' Bulletins.		Department Bulletins, Reports, etc.		Periodical publications.		Congressional.	
	Copies.	Cost.	Copies.	Cost.	Copies.	Cost.	Copies.	Cost.	Copies.	Cost.
Bureaus:										
Division of Accounts and Disbursements.....	441, 148	\$1, 565. 71							300	\$15. 68
Bureau of Animal Industry.....	10, 775, 787	25, 463. 68			833, 565	\$9, 288. 29			2, 500	183. 85
Bureau of Biological Survey.....	649, 826	5, 255. 78			64, 500	3, 221. 36			2, 500	46. 90
Bureau of Chemistry.....	1, 993, 742	21, 153. 41			123, 500	4, 486. 14			2, 500	61. 34
Bureau of Crop Estimates.....	7, 687, 320	35, 384. 09			12, 000	608. 95			2, 500	40. 21
Bureau of Entomology.....	1, 359, 774	14, 207. 21			320, 675	10, 350. 09			2, 500	65. 49
Office of Farm Management.....	391, 606	6, 954. 89			184, 000	6, 186. 78			1, 000	21. 60
Federal Horticultural Board.....	409, 625	2, 216. 45							2, 500	61. 09
Forest Service.....	5, 516, 331	26, 346. 23			198, 000	7, 723. 48			2, 500	140. 57
Insecticide and Fungicide Board.....	155, 128	1, 706. 75			5, 000	43. 26			5, 000	13. 33
Library.....	202, 722	12, 068. 38							750	50. 08
Bureau of Markets.....	7, 308, 519	20, 068. 49			470, 000	8, 530. 83			6, 500	135. 91
Bureau of Plant Industry.....	5, 509, 841	41, 491. 92			1, 973, 530	26, 993. 79			2, 500	110. 06
Office of Public Roads and Rural Engineering.....	396, 111	5, 996. 86			113, 000	3, 404. 45				
Division of Publications.....	12, 434, 079	15, 931. 54					9, 000	1, 128. 81	1, 000	2. 70
Office of the Secretary.....	117, 486, 565	187, 660. 67	21, 699, 000	\$198, 840. 44			2, 229, 200	4, 100. 96	45, 886	114. 22
Bureau of Soils.....	326, 534	8, 637. 80					7, 560, 500	58, 111. 97	48, 500	7, 565. 95
Office of the Solicitor.....	52, 106	703. 96			6, 000	291. 27			1, 500	94. 98
States Relations Service.....	14, 875, 149	72, 400. 26			1, 380, 970	19, 235. 82	150, 000	15, 120. 29	12, 000	3, 914. 27
Weather Bureau ²	14, 974, 940	37, 997. 39			19, 050	5, 622. 94	24, 750	11, 484. 40	1, 011	4, 126. 30
Projects:										
Agricultural Atlas.....	14, 762	3, 140. 84								
Report on the Lumber Industry.....	112, 000	4, 724. 78			112, 000	4, 724. 78				
Total (except Farmers' Bulletins).....	103, 073, 635	451, 077. 12								
Farmers' Bulletins.....	21, 699, 000	198, 840. 44	21, 699, 000	198, 840. 44	5, 817, 290	110, 735. 38	12, 064, 450	108, 666. 81	143, 547	26, 555. 77
Total (including Farmers' Bulletins).....	124, 772, 635	649, 917. 56								

¹ Farmers' Bulletins are not included in this total, as they are contributed by various bureaus.

² The Division of Publications does not have supervision of the appropriation for the Weather Bureau. A statement of the expenditures for that bureau, however, is included in order to show the total expenditures from the regular fund for printing and binding.

Bureau or project.

Bureaus:

Bureau or project.	Miscellaneous administrative circulars, orders, decisions, notices, etc.		Separates and unnumbered pamphlets		Compilations of laws, manuals, fiscal regulations, etc.		Binding.		Index cards.	
	Copies.	Cost.	Copies.	Cost.	Copies.	Cost.	Copies.	Cost.	Copies.	Cost.
Division of Accounts and Disbursements.....										
Bureau of Animal Industry.....	5,314,400	\$5,604.98	92,250	\$1,218.46			10	\$4.67	61,000	\$133.13
Bureau of Biological Survey.....	25,700	135.72	15,500	243.45			74	65.05	900,300	1,416.90
Bureau of Chemistry.....	526,000	11,144.45	18,600	285.23			128	216.51	39,000	82.98
Bureau of Crop Estimates.....	343,000	1,152.26	33,000	668.09			1,295	1,382.49	49,500	234.41
Bureau of Entomology.....	10,000	41.21	33,450	789.57			120	294.24	315,200	344.28
Office of Farm Management.....			7,700	228.98			1,064	96.65	174,700	375.35
Federal Horticultural Board.....	106,950	1,445.93					51	102.25	50,000	49.14
Forest Service.....	571,750	3,265.21	2,000	130.37					5,700	38.71
Insecticide and Fungicide Board.....	82,000	1,476.25			18,000	1,194.48	3,871	1,044.94	757,300	2,245.60
Library.....									9,000	25.95
Bureau of Markets.....	187,133	351.17	25,000	189.34			11,757	10,498.89	49,200	1,333.38
Bureau of Plant Industry.....	340,600	2,677.77	123,750	5,318.23			211	227.55	2,117,300	3,761.22
Office of Public Roads and Rural Engineering.....	2,500	68.02	14,135	339.95			254,395	935.74	853,000	1,485.01
Division of Publications.....	5,000	43.92	8,907,000	9,692.11			49	41.42	45,000	101.92
Office of the Secretary.....	442,000	2,968.57	3,867,200	2,160.24			1,853	109.32	532,000	904.16
Bureau of Soils.....			6,000	71.04			312	354.73	127,000	750.71
Office of the Solicitor.....	26,000	63.81					6	11.39	1,000	12.54
States Relations Service.....	2,374,750	13,858.15	8,600	273.40			5,016	118.06	7,000	50.46
Weather Bureau ¹			36,240	706.93			732	856.44	6,703,852	6,529.53
Projects:							1,757	3,865.42	13,000	27.44
Agricultural Atlas.....										
Report on the Lumber Industry.....										
Total.....	10,357,783	44,297.42	13,190,425	22,345.42	20,000	2,661.16	282,731	20,225.76	12,870,652	19,945.85

¹ The Division of Publications does not have supervision of the appropriation for the Weather Bureau. A statement of the expenditures for that bureau, however, is included in order to show the total expenditures from the regular fund for printing and binding.

STATISTICS OF THE PUBLICATION WORK.

For general information and as a matter of record the following statistics are given with regard to the publication work of the year:

Contributions by the various bureaus to the Department series of bulletins and to the Farmers' Bulletin series issued during the year.

Bureau.	Department Bulletins.						Farmers' Bulletins.					
	New.			Reprints.			New.			Reprints.		
	Number.	Pages.	Copies.	Number.	Pages.	Copies.	Number.	Pages.	Copies.	Number.	Pages.	Copies.
Animal Industry	15	451	94,000	1	11	5,000	20	476	2,120,000	58	1,229	3,840,000
Biological Survey	3	147	15,000				7	194	475,000	12	266	270,000
Chemistry	12	276	73,500	3	122	12,000				3	101	40,000
Crop Estimates	2	107	20,000									
Entomology	18	750	54,500				30	747	1,125,000	29	661	820,000
Farm Management	21	746	86,000	1	15	3,000	11	219	870,000	7	157	125,000
Forest Service	15	580	139,000				2	46	55,000	2	48	45,000
Markets	8	488	123,000				7	134	635,000	7	166	257,000
Plant Industry	21	444	121,000	1	27	2,500	33	834	3,660,000	88	2,138	2,440,000
Public Roads	6	326	29,000	3	348	2,500	10	290	405,000	4	120	100,000
Secretary							1	12	100,000	1	29	100,000
Soils	2	50	6,000				1	30	5,000	1	23	10,000
States Relations	10	278	85,500	2	48	20,000	7	176	1,325,000	27	842	2,837,000
Weather							1	32	40,000			
Total	133	4,643	846,500	11	571	45,000	130	3,190	10,815,000	236	5,252	10,884,000

New publications and reprints issued during the year ended June 30, 1918.

PUBLICATIONS OF ALL CLASSES, EXCEPT PERIODICALS.

Class.	New publications.			Reprints.		
	Number.	Pages.	Copies.	Number.	Pages.	Copies.
Department Bulletins	133	4,643	846,500	11	571	45,000
Farmers' Bulletins	130	3,190	10,815,000	236	5,252	10,884,000
Soil surveys	45	2,146	45,000			
Secretary's report to the President	1	46	5,000			
Annual report, Department of Agriculture	1	508	400			
Annual reports, bureaus, divisions, and offices	27	1,956	66,550			
Yearbook	1	853	30,000			
Yearbook separates	39	748	238,000	8	135	29,500
Journal of Agricultural Research separates	129	2,500	125,131			
Miscellaneous separates and pamphlets	14	713	1,151,310	6	20	4,900,000
Circulars, Office of Secretary	66	866	12,567,400	16	179	2,307,000
Circulars, bureaus, divisions, and offices	85	961	9,014,500	19	207	1,681,500
Miscellaneous bulletins and reports	20	1,489	170,390	7	441	17,500
Orders, notices, decisions, etc.	47	321	315,900	27	172	38,500
Service and regulatory announcements	77	2,364	1,322,503	11	207	44,500
Compilations of laws, manuals, etc.	6	473	25,000			
Total	821	23,777	36,738,494	341	7,184	19,947,500
New publications and reprints combined				1,162	30,961	56,685,994

New publications and reprints issued during the year ended June 30, 1918—Continued.

PERIODICAL PUBLICATIONS.

Name of periodical.	Bureau or office.	Number of issues.	Pages.	Copies.
Weekly News Letter.....	Secretary.....	53	428	6, 197, 500
Journal of Agricultural Research.....	do.....	50	2, 893	100, 000
Experiment Station Record.....	States Relations.....	17	2, 264	127, 500
Monthly Crop Report.....	Crop Estimates.....	12	148	2, 278, 000
Monthly List of Publications.....	Publications.....	12	56	2, 229, 000
Public Roads.....	Roads.....	2	92	9, 000
Seed Reporter.....	Markets.....	9	72	119, 000
Food Surveys.....	do.....	9	180	334, 700
Total periodicals.....		164	6, 033	11, 394, 700

Copies of publications of all kinds, new and reprints, issued by the department, 1890–1918, inclusive.

Year.	Number of copies.	Year.	Number of copies.	Year.	Number of copies.	Year.	Number of copies.
1890.....	1, 904, 300	1898.....	6, 280, 365	1906.....	13, 488, 527	1914.....	38, 186, 392
1891.....	2, 833, 933	1899.....	7, 075, 975	1907.....	16, 746, 910	1915.....	36, 075, 561
1892.....	2, 348, 797	1900.....	7, 152, 428	1908.....	16, 875, 516	1916.....	39, 098, 239
1893.....	3, 446, 181	1901.....	7, 889, 281	1909.....	17, 190, 345	1917.....	47, 023, 635
1894.....	3, 169, 310	1902.....	10, 586, 580	1910.....	25, 190, 465	1918.....	¹ 97, 259, 399
1895.....	4, 100, 660	1903.....	11, 698, 564	1911.....	27, 594, 877	Total...	549, 250, 616
1896.....	6, 561, 700	1904.....	12, 421, 386	1912.....	34, 678, 557		
1897.....	6, 541, 210	1905.....	12, 475, 157	1913.....	33, 356, 366		

¹ Includes publications charged to the emergency fund for "stimulating agriculture."

FARMERS' BULLETINS.

All previous records with regard to Farmers' Bulletins were broken, 130 new bulletins in this series having been issued during the year. The number contributed by each bureau is shown in the table on page 7. The first editions of these bulletins aggregated 6,045,000 copies. The reprints ordered of these and of 236 earlier bulletins totaled 15,654,000 copies, making an aggregate of 21,699,000 copies of Farmers' Bulletins ordered during the year.

The following is a list of new Farmers' Bulletins issued during the year, showing the initial editions ordered:

New Farmers' Bulletins issued during the year ended June 30, 1918, with the size of the first editions.

No.	Title.	Copies.
897.	Sweet Clover: Growing the Crop.....	30, 000
802.	The Classification and Grading of American Upland Cotton.....	30, 000
805.	Drainage of Irrigated Farms.....	15, 000
813.	Construction and Use of Farm Weirs.....	20, 000
819.	The Tobacco Budworm and Its Control in the Southern Tobacco Districts.....	20, 000
824.	How to Select Foods: III. Foods Rich in Protein.....	50, 000
825.	Pit Silos.....	30, 000
826.	Eradicating Tall Larkspur on Cattle Ranges in the National Forests.....	20, 000
828.	Farm Reservoirs.....	15, 000
829.	Asparagus.....	30, 000
830.	Marketing Eggs by Parcel Post.....	30, 000
831.	The Red Spider on Cotton and How to Control It.....	20, 000
832.	Trapping Moles and Utilizing Their Skins.....	10, 000
833.	Methods of Controlling or Eradicating the Wild Oat in the Hard Spring Wheat Area.....	30, 000
834.	Hog Cholera: Prevention and Treatment.....	30, 000
836.	Sweet Clover: Harvesting and Thrashing the Seed Crop.....	30, 000
837.	The Asparagus Beetles and Their Control.....	20, 000
840.	Farm Sheep Raising for Beginners.....	50, 000
842.	Modern Methods of Protection Against Lightning.....	20, 000
843.	Important Pecan Insects and Their Control.....	20, 000
844.	How to Attract Birds in the Middle Atlantic States.....	15, 000

New Farmers' Bulletins issued during the year ended June 30, 1918, with the size of the first editions—Continued.

No.	Title.	Copies.
845.	The Gipsy Moth and the Brown-Tail Moth and Their Control	20,000
846.	The Tobacco Beetle and How to Prevent Loss from It	20,000
847.	Potato Storage and Storage Houses	50,000
848.	The Boll Weevil Problem	20,000
849.	Capon and Caponizing	30,000
850.	How to Make Cottage Cheese on the Farm	50,000
851.	The House Fly	20,000
853.	Home Canning of Fruits and Vegetables	100,000
854.	Strawberry Culture in Tennessee, Kentucky, and West Virginia	20,000
855.	Homemade Silos	40,000
856.	Control of Diseases and Insect Enemies of the Home Vegetable Garden	50,000
857.	Screw-Worms and Other Maggots Affecting Animals	15,000
858.	The Guinea Fowl	30,000
859.	Home Uses for Muscadine Grapes	30,000
860.	Cranberry-Insect Problems and Suggestions for Solving Them	20,000
861.	Removal of Stains from Clothing and Other Textiles	50,000
862.	The Common Mealybug and Its Control in California	20,000
863.	Irrigation of Grain	20,000
864.	Practical Information for Beginners in Irrigation	20,000
865.	Irrigation of Alfalfa	20,000
866.	The Use of Windmills in Irrigation in the Semiarid West	20,000
867.	Tobacco Hornworm Insecticide: Use of Powdered Arsenate of Lead in Dark-Tobacco Districts	15,000
868.	How to Increase the Potato Crop by Spraying	15,000
869.	The Muskrat as a Fur Bearer, with Notes on Its Use as Food	15,000
870.	The Community Fair	30,000
871.	Fresh Fruits and Vegetables as Conservers of Other Staple Foods	50,000
872.	The Bollworm, or Corn Ear Worm	20,000
873.	Utilization of Farm Wastes in Feeding Live Stock	50,000
874.	Swine Management	50,000
875.	The Rough-headed Corn Stalk-Beetle and Its Control	20,000
876.	Making Butter on the Farm	50,000
877.	Human Food from an Acre of Staple Farm Products	30,000
878.	Grains for Western North and South Dakota and Eastern Montana	20,000
879.	Home Storage of Vegetables	250,000
880.	Fumigation of Ornamental Greenhouse Plants with Hydrocyanic-Acid Gas	20,000
881.	Preservation of Vegetables by Fermentation and Salting	150,000
882.	Irrigation of Orchards	30,000
883.	Grains for the Utah Dry Lands	20,000
884.	Saving Vegetable Seeds for the Home and Market Garden	50,000
885.	Wheat Growing in the Southeastern States	150,000
886.	Harvesting Soy Beans for Seed	60,000
888.	Advice to Forest Planters in the Plains Region	20,000
889.	Back-Yard Poultry Keeping	50,000
890.	How Insects Affect the Cotton Plant and Means of Combating Them	30,000
891.	The Corn Root-Aphis and Methods of Controlling It	20,000
892.	Spring Oat Production	50,000
893.	Breeds of Dairy Cattle	50,000
894.	Rye Growing in the Southeastern States	40,000
895.	Growing Winter Wheat on the Great Plains	30,000
896.	House Rats and Mice	50,000
897.	Fleas and Their Control	20,000
898.	Standard Varieties of Chickens. II. The Mediterranean and Continental Classes	50,000
899.	Surface Irrigation for Eastern Farms	20,000
900.	Homemade Fruit Butters	100,000
901.	Everbearing Strawberries	30,000
902.	The Silverfish or "Slicker": An Injurious Household Insect	15,000
904.	Fire Prevention and Fire Fighting on the Farm	30,000
906.	The Self-Feeder for Hogs	30,000
907.	Bean Growing in Eastern Washington and Oregon and Northern Idaho	30,000
908.	Information for Fruit Growers about Insecticides, Spraying Apparatus, and Important Insect Pests	20,000
909.	Cattle Lice and How to Eradicate Them	50,000
910.	Game Laws for 1917	20,000
911.	Laws Relating to Fur-Bearing Animals, 1917	15,000
912.	How to Attract Birds in the East Central States	15,000
913.	Killing Hogs and Curing Pork	50,000
914.	Control of the Melon Aphis	20,000
915.	How to Reduce Weevil Waste in the Southern Corn Crop	100,000
916.	A Successful Community Drying Plant	50,000
917.	Growing Peaches: Sites and Cultural Methods	30,000
918.	Growing Peaches: Varieties, Classification, and Propagation	30,000
919.	The Application of Dockage in the Marketing of Wheat	80,000
920.	Milk Goats	30,000
921.	The Principles of the Liming of Soils	5,000
922.	Parcel-Post Business Methods	50,000
923.	Fumigation of Citrus Trees	20,000
924.	A Simple Way to Increase Crop Yields	50,000
925.	Cabbage Diseases	30,000
926.	Some Common Disinfectants	30,000
927.	Farm Home Conveniences	150,000
928.	Control of the Argentine Ant in Orange Groves	20,000
929.	The Place of Sheep on New England Farms	20,000
930.	Marketing Butter and Cheese by Parcel Post	30,000

New Farmers' Bulletins issued during the year ended June 30, 1918, with the size of the first editions—Continued.

No.	Title.	Copies.
931.	Soy Beans in Systems of Farming in the Cotton Belt	20,000
933.	Spraying for the Control of Insects and Mites Attacking Citrus Trees in Florida	20,000
934.	Home Gardening in the South	100,000
935.	The Sheep-Killing Dog	30,000
936.	The City and Suburban Vegetable Garden	150,000
937.	The Farm Garden in the North	250,000
938.	Apple Bitter-Rot and Its Control	30,000
939.	Cereal Smuts and the Disinfection of Seed Grain	50,000
940.	Common White Grubs	20,000
942.	Controlling the Clover-Flower Midge in the Pacific Northwest	20,000
943.	Haymaking	30,000
946.	Care and Repair of Farm Implements. III. Plows and Harrows	50,000
947.	Care and Repair of Farm Implements. IV. Mowers, Reapers, and Binders	50,000
948.	The Rag-Doll Seed Tester	75,000
949.	Dehorning and Castrating Cattle	30,000
950.	The Southern Corn Rootworm and Farm Practices to Control It	20,000
953.	Potato Culture Under Irrigation	30,000
955.	Use of Wheat-Flour Substitutes in Baking	275,000
956.	Curing Hay on Trucks	30,000
958.	Standard Broom Corn	30,000
966.	A Simple Hog-Breeding Crate	200,000
970.	Sweet-Potato Storage	30,000
979.	Preparation of Strawberries for Market	50,000
987.	Labor-Saving Practices in Haymaking	150,000
989.	Better Use of Man Labor on the Farm	200,000
991.	The Efficient Operation of Thrashing Machines	200,000
994.	Commercial Bordeaux Mixtures: How to Calculate Their Values	30,000
Total of first editions of Farmers' Bulletins		6,045,000

Manuscripts for 40 new Farmers' Bulletins were sent to the Government Printing Office during the latter part of the fiscal year 1917, but were not published until the fiscal year 1918, and 86 reprints of Farmers' Bulletins likewise were carried over from the fiscal year 1917.

The appropriation for Farmers' Bulletins was \$200,000, and approximately 25,000 copies were allotted to each Senator, Representative, and Delegate in Congress. The congressional distribution during the year aggregated 9,098,482 copies, and 14,039,047 copies were distributed by the department.

The following statement shows the number of Farmers' Bulletins issued during the 29 years since the series was inaugurated, with the congressional distribution for each year:

Output of Farmers' Bulletins during 29 years, with congressional distribution.

Year.	New bul- letins issued.	Total num- ber of copies.	Copies dis- tributed by Congress- men.	Year.	New bul- letins issued.	Total num- ber of copies.	Copies dis- tributed by Congress- men.
1890-1893.....	14	540,000	.....	1907.....	42	6,469,000	3,484,713
1894.....	5	278,500	.....	1908.....	26	6,574,500	3,928,437
1895.....	11	1,567,000	885,770	1909.....	34	7,755,000	3,960,642
1896.....	13	1,891,000	1,316,695	1910.....	45	9,337,500	6,449,589
1897.....	16	2,387,000	1,967,237	1911.....	48	9,219,000	5,474,079
1898.....	21	2,170,000	1,580,065	1912.....	44	10,409,000	7,351,262
1899.....	22	2,437,000	1,101,985	1913.....	42	9,680,850	5,803,088
1900.....	18	2,360,000	1,666,909	1914.....	55	14,960,000	8,399,759
1901.....	14	3,345,000	2,195,010	1915.....	77	14,795,000	7,402,072
1902.....	23	6,150,000	4,289,126	1916.....	62	12,795,000	6,479,178
1903.....	22	6,602,000	3,954,976	1917.....	84	15,177,800	8,811,150
1904.....	25	6,435,000	4,895,556	1918.....	130	23,137,529	9,098,482
1905.....	24	5,925,500	4,782,613	Total.....	950	188,966,179	110,588,899
1906.....	33	6,568,000	5,279,476				

A notable improvement in the character and form of these popular publications was accomplished during the year. Many of the old Farmers' Bulletins were revised, reduced in number of pages, and reprinted with attractive cover designs and text illustrations.

PUBLICATIONS RELATING TO FOOD PRODUCTION AND CONSERVATION.

The intensive campaign to increase food production and to conserve the food supply begun last year was continued.

For emergency printing, to assist in this campaign, the department had a special appropriation. This was utilized in the printing and distribution of various reports, leaflets, documents, informational circulars, etc., requiring immediate dissemination. The expenditures for such emergency printing aggregated about \$235,000. Some of the regular publications also were utilized in the department's campaign. This is indicated in the statement following, showing the total number of copies of certain Farmers' Bulletins issued during the year:

	Copies.
No. 824. How to Select Foods: III. Foods Rich in Protein.....	200,000
840. Farm Sheep Raising for Beginners.....	90,000
850. How to Make Cottage Cheese on the Farm.....	150,000
853. Home Canning of Fruits and Vegetables.....	100,000
871. Fresh Fruits and Vegetables as Conservers of Other Staple Foods.....	50,000
879. Home Storage of Vegetables.....	250,000
881. Preservation of Vegetables by Fermentation and Salting.....	300,000
884. Saving Vegetable Seeds for the Home and Market Garden.....	100,000
900. Homemade Fruit Butters.....	150,000
915. How to Reduce Weevil Waste in Southern Corn.....	100,000
924. A Simple Way to Increase Crop Yields.....	50,000
934. Home Gardening in the South.....	700,000
936. The City and Suburban Vegetable Garden.....	350,000
937. The Farm Garden in the North.....	350,000
955. Use of Wheat Flour Substitutes in Baking.....	375,000
966. A Simple Hog-Breeding Crate.....	200,000
987. Labor-Saving Practices in Haymaking.....	150,000
991. The Efficient Operation of Thrashing Machines.....	200,000
Total.....	3,865,000

EMERGENCY LEAFLETS, PAMPHLETS, CIRCULARS, FOLDERS, AND POSTERS.

The titles and editions of the emergency leaflets, pamphlets, circulars, folders, and posters issued during the year are given in the statements following:

LEAFLETS.

United States Food Leaflets:	Copies.
No. 1. Start the Day Right.....	1,000,000
2. Do You Know Corn Meal?.....	1,000,000
3. A Whole Dinner in One Dish.....	1,000,000
4. Choose Your Food Wisely.....	1,000,000
5. Make a Little Meat Go a Long Way....	1,000,000
6. Do You Know Oatmeal?.....	1,000,000
7. Food for Your Children.....	1,000,000
8. Instead of Meat.....	1,000,000
9. Vegetables for Winter.....	1,000,000
10. Plenty of Potatoes.....	1,000,000
11. Milk the Best Food We Have.....	1,000,000
12. Save Fuel When You Cook.....	1,000,000
13. Let the Fireless Cooker Help You Conquer.....	1,000,000
14. Save Sugar: Use Other Sweets.....	1,000,000
15. Dry Peas and Beans.....	1,000,000
16. Fresh Vegetables.....	750,000
17. Use More Fish.....	750,000
18. Rice.....	750,000
19. Hominy.....	750,000
20. Wheatless Bread and Cakes.....	750,000

Other leaflets:	Copies.
First Care of Baby Chicks.....	350,000
Farm Labor Problem.....	7,500
Five Little Pigs.....	100,000
Pork Production in 1918.....	15,000
The President to the Farmers.....	310,000
Common Poultry Diseases.....	20,000
Seeds and Plants for Home Garden.....	150,000
Selection and Care of Poultry Breeding Stock.....	10,000
Plant a Garden.....	150,000
A Simple Trap Nest for Poultry.....	10,000
Care and Feeding of Chicks.....	20,000
How to Set a Hen and Care for Her.....	20,000
Ways to Use Cottage Cheese.....	100,000
Cottage Cheese, an Inexpensive Meat Substitute.....	100,000
Some Directions for Making Cottage Cheese.....	100,000
Use Potatoes to Save Wheat.....	400,000
Chinch-Bug Leaflet.....	60,000
Grasshopper Control.....	100,000
Cutworm Leaflet.....	40,000
Grasshoppers.....	65,000
Turn Cold into Gold.....	800,000
Skim Milk for Human Food.....	200,000
Potato Black Heart.....	7,500
Home Canning of Meats and Sea Food.....	50,000
The Cattle Tick and the War.....	250,000
Spray Schedules for Apples.....	25,000
Potato Beetles.....	50,000
Spraying Potato Fields.....	75,000
Garden Plant Lice.....	75,000
Cabbage Worm.....	75,000
Movable Hog Houses.....	50,000
Apple Spraying Schedule, Southern States.....	20,000
Total leaflets.....	22,555,000

PAMPHLETS.

Why We Went to War.....	35,000
Steps to Victory.....	28,000
Movable Hog Houses.....	200,000
A City Woman Who Found Her War Job on the Farm.....	250,000
Total pamphlets.....	513,000

CIRCULARS AND FOLDERS.

Swine Production Should Be Increased.....	10,000
Preserving Eggs in Waterglass Solution and Limewater.....	700,000
Safe Farming and What It Means for the South in 1918.....	100,000
Back Yard Poultry Keeping.....	100,000
American Standard Poultry.....	100,000
Women on the Farm.....	250,000
Control of Potato Leaf Spot.....	20,000
Powdery Dry Rot of Potatoes.....	7,000
Use Potatoes to Save Wheat.....	500,000
Egg Circular for Southern States.....	10,000
Cottage Cheese Dishes.....	300,000
Saving Eggs Is Public Service.....	550,000
Use Barley, Save Wheat.....	120,000
Use Peanut Meal to Save Wheat and Fat.....	200,000
Use Soy Bean Meal to Save Wheat, Meat, Fat.....	150,000
Selection and Treatment of Seed Potatoes to Avoid Disease.....	30,000
It is Possible to Prevent Grain Dust Explosions and Fires.....	25,000
Put a Stop to Grain Dust Explosions and Fires in Thrashing Machines...	25,000
Points for Poultry Packers.....	30,000
Points for Egg Buyers.....	20,000
Raise Chickens.....	100,000
Total circulars and folders.....	3,347,000

POSTERS.

	Copies.
Raise More Poultry.....	400, 000
The Sweet Potato Weevil.....	10, 000
Have Eggs to Sell When Eggs Are Scarce.....	250, 000
Raise Pigs and Help Win the War.....	50, 000
Do Not Sell Laying Hens.....	155, 500
Rats.....	50, 000
Cutworms.....	20, 000
Chinch Bug.....	15, 000
Turn Cold into Gold.....	200, 000
Fight Wheat Rust.....	100, 000
Potato Beetles.....	25, 000
Grasshoppers.....	20, 000
Garden Cutworms.....	25, 000
Save Seed for Victory.....	100, 000
Dust Explosions and Fires in Mills.....	25, 000
Spraying Potato Fields.....	35, 000
Garden Plant Lice.....	40, 000
Cabbage Worm.....	30, 000
Food is Going Up in Smoke.....	25, 000
The Country Needs You to Harvest Corn—The Country Needs You to Harvest Cotton.....	50, 000
Raise More Poultry.....	150, 000
Apple Spraying Schedule, Southern States.....	10, 000
Spray Schedule for Apples, Northern States.....	8, 000
Make Every Egg Count.....	50, 000
Total posters.....	1, 843, 500

Under the supervision of the assistant in charge of the document section, the above were distributed largely through the department's county and demonstration agents, directors of extension work, and other official channels, as well as civic organizations and patriotic clubs throughout the country. Many were shipped directly from printing plants to the distributing points.

An aggregate of 28,258,500 copies of such emergency educational material was distributed during the year.

PUBLICATION WORK OF THE WEATHER BUREAU.

Of the sum appropriated for the department's printing, not exceeding \$47,000 is provided for the use of the Weather Bureau. The printing for the bureau is not done under the supervision of this division, but in order to bring together a report for the entire department the following list is furnished by that bureau:

Publications of the Weather Bureau.

NEW PUBLICATIONS (NOT PERIODICALS).

Publication.	Copies.
Daily River Stages at River Gage Stations on the Principal Rivers of the United States, for the Year 1916. Vol. XIV. 278 pp. W. B. No. 611.....	650
Radiographic Weather Code for Vessel Weather Observers. 52 pp. W. B. No. 616.....	500
Aerology No. 3. Monthly Weather Review Supplement No. 7 52 pp., 4 figs. W. B. No. 619....	1,500
Instructions for Installation and Use of Telethermoseopes. 12 pp., 6 figs. W. B. No. 637.....	300
Instructions Governing the Corn and Wheat, Cotton, Sugar and Rice, and Cattle Region Services. 4th ed. 8 pp. W. B. No. 639.....	1,000
Instructions to Operators on the U. S. Weather Bureau Telegraph and Telephone Lines. 36 pp., 1 fig. W. B. No. 641.....	200
Aerology No. 4. Monthly Weather Review Supplement No. 8. 112 pp., 12 figs. W. B. No. 642....	1,500
Periodical Events and Natural Law as Guides to Agricultural Research and Practice. Monthly Weather Review Supplement No. 9. 42 pp., 24 figs. W. B. No. 643.....	2,000
Annual Report of the Chief of the Weather Bureau, 1916-17. 292 pp., 7 charts. Congressional....	1,000

PERIODICAL PUBLICATIONS.

Periodical.	Copies per issue.	
	July 1, 1917.	June 30, 1918.
Monthly Weather Review (monthly).....	1,475	1,475
Climatological Data for the United States (monthly).....	310	310
Washington Weather Map, first edition (daily, except Sundays and holidays).....	850	730
Washington Weather Map, second edition (daily, except Sundays and holidays).....	385	390
Washington Weather Map (Sundays and holidays edition).....	475	455
National Weather and Crop Bulletin (weekly from April to September, monthly from October to March).....	4,200	3,550
Snow and Ice Bulletin (weekly during winter).....	1,210	1,130
Forecast cards (daily, except Sundays and holidays).....	1,570	1,250
Weekly forecasts (weekly).....	875	165
Meteorological Summary for Washington (monthly).....	250	200

SALES OF DEPARTMENT PUBLICATIONS.

The sales of department publications of all kinds by the Superintendent of Documents aggregated 226,890 copies, for which he received \$20,587.88.

The remittances received in this division in payment for bulletins, reports, etc., aggregated \$3,322.28. A record was kept of all such money and the publications desired, and the correspondence and the money were forwarded day by day, as received, to the Superintendent of Documents, who receipted for the amount and sent the publications requested. The amount of money forwarded to the department for publications continues to increase, notwithstanding the announcements that are made in all our lists that applications for the purchase of publications should be made only to the Superintendent of Documents. This division, however, has cheerfully cooperated with the Superintendent of Documents, receiving and forwarding to him all remittances, avoiding any delay.

Some of the publications regarded by the Superintendent of Documents as the best sellers are shown in the following statement:

Publications sold by the Superintendent of Documents.

Publication.	Copies sold.	Price received.
Department Bulletin 576, Factory Manufacture of Cottage Cheese.....	5,000	\$52.00
Department Bulletin 631, Five Years' Calf-Feeding in Alabama and Mississippi.....	2,000	43.00
Farmers' Bulletin 142, Principles of Nutrition and Nutritive Value of Food.....	1,655	82.75
Farmers' Bulletin 203, Canned Fruits, Preserves, and Jellies.....	1,269	63.45
Farmers' Bulletin 513, Fifty Common Birds of Farm and Orchard.....	1,998	299.70
Farmers' Bulletin 807, Bread and Bread Making.....	1,282	64.00
Farmers' Bulletin 813, Construction and Use of Farm Weirs.....	2,500	27.65
Farmers' Bulletin 839, Home Canning by the One-Period Cold-Pack Method.....	4,100	93.00
Special Report on Diseases of Cattle.....	428	428.00
Special Report on Diseases of the Horse.....	663	663.00
Bulletin 28, Office of Experiment Stations, Composition of American Food Materials.....	5,431	543.10
Food Charts.....	15,120	1,008.00
First Aid Manual for Field Parties.....	4,000	153.00

Numerous orders for 2,000 soil surveys were filled, and there were some sales of practically every publication issued during the year.

The sales of department publications during the last nine years and the amounts received are shown in the following table:

Department publications sold by the Superintendent of Documents.

Year.	Number of copies.	Amount received.	Year.	Number of copies.	Amount received.
1910.....	147,327	\$18,398.18	1915.....	335,863	\$23,011.10
1911.....	183,577	18,657.17	1916.....	327,381	22,277.84
1912.....	171,866	16,428.07	1917.....	364,100	26,241.69
1913.....	183,139	17,885.40	1918.....	226,800	20,587.88
1914.....	231,821	21,708.76			

The publications sent out by the Superintendent of Documents on paid subscription lists were as follows:

	Copies.
Journal of Agricultural Research.....	4,043
Experiment Station Record.....	5,892
Bureau of Animal Industry Service and Regulatory Announcements.....	332
Monthly Weather Review.....	1,427
Weekly News Letter.....	10,884
Total.....	32,578

WORK OF THE DIVISION, BY BRANCHES.

The work of the division is divided into four principal branches. A brief statement regarding the operations of each follows:

EDITORIAL SECTION.

The editorial section of the division, in charge of Mr. B. D. Stallings, assistant chief, was occupied during the year in assembling manuscripts, seeing that they were ready for the printer, issuing requisitions for printing, transmitting manuscripts and other material to the Government Printing Office, supervising the reproduction

of illustrations, distributing proofs and returning them to the printing office, and following up the work in hand, with a view to facilitating delivery.

The editing of the manuscripts was done in the Office of the Secretary, under the immediate direction of the chief editor, Mr. Edwy B. Reid, acting under the general supervision of Mr. Clarence Ousley, Assistant Secretary in charge of the department's publication activities. The chief editor, with a small force of assistant editors, examined, criticized, edited, and approved all manuscripts before they were forwarded for printing. The chief editor frequently called upon the Committee on Examination of Manuscripts, which acts in an advisory capacity, for advice on matters of policy and classification.

The quantity of editorial work, both of the chief editor's office and of the editorial section of this division, is reflected in the tabulated statement showing the number of publications issued during the year. The work comprised, besides the regular publications, numerous emergency circulars, leaflets, posters, etc., used by the department in its campaign to increase crop production. These circulars, as well as the Farmers' Bulletins, were edited with a view to presenting information briefly and interestingly for popular reading. Attention was given also to printing them in attractive and at the same time economical form, so as better to accomplish the instructional purpose for which they were issued. It is believed that a noticeable improvement in the subject matter as well as in the general appearance of all published material has been achieved during the year.

The following statement, showing the number of new publications and reprints issued during the year, and for comparison those issued during the preceding nine years, indicates the volume of editorial work:

New publications, ten years, 1909 to 1918.

Class.	1909	1910	1911	1912	1913	1914	1915	1916	1917	1918
New publications...	650	1,085	1,170	1,250	1,771	1,152	913	944	1,132	2,205
Reprints.....	485	462	696	648	429	474	393	357	390	341
Total.....	1,135	1,547	1,866	1,898	2,200	1,626	1,306	1,301	1,522	2,546

The miscellaneous printing, such as blanks, circulars of inquiry, blank books, and job work generally, was handled as heretofore in the editorial section.

INDEXING SECTION.

An increasing demand for references to department publications to be found in the card indexes in the Indexing Section has been noticed, especially in the second half of the year.

When an investigation on any subject is proposed, the investigator usually would find useful a full list of all references to the subject in the department publications. Such lists as have been called for have usually been furnished by the Indexing Section in a day or two at most.

All who have asked for such lists have expressed appreciation of their usefulness, and this indicates that the lists would be asked for very often if the indexes were frequently brought to the attention of investigators and others desiring accurate information with regard to the published literature of the department.

The reading of the Congressional Record and the supplying of congressional documents to other branches of the department has gone forward with better understanding of the needs and with apparent increased appreciation of the usefulness of the work. Under a new arrangement copies of the Congressional Record for the department are being received more regularly and earlier.

Calls have come in for the Yearbook and Farmers' Bulletin indexes, continuing the five-year series of the former and the cumulative index of the first 500 of the latter. It is hoped that this work can be taken up early in the present fiscal year.

The indexes for volumes of 25 each of the Farmers' Bulletins and of the Department Bulletins are going forward in spite of interruptions, and the plan of making duplicate cards inaugurated at the beginning of the year is proving effective in bringing the work to date.

The binding of department publications for permanent preservation has been provided for, and the books are in the Public Printer's hands with necessary instructions. It is hoped that they will be delivered within the first quarter of the fiscal year 1919, and that by that time a place will have been provided for the safe keeping of this set of books, the destruction of which would be a public calamity.

The indexing section is in charge of Mr. C. H. Greathouse.

ILLUSTRATIONS SECTION.

The illustrations section continued in charge of Mr. A. B. Boettcher.

The drawings prepared by the draftsmen during the year numbered 2,483, compared with 1,840 during the preceding year, although during the greater part of the year the drafting force was much depleted through the induction of several of its members into the military service.

Summary of drawings prepared during the fiscal year 1918.—Office of the Secretary, 331; Bureau of Plant Industry, 302; Bureau of Animal Industry, 704; Forest Service, 9; Bureau of Chemistry, 57; Bureau of Biological Survey, 22; Bureau of Crop Estimates, 71; Bureau of Entomology, 69; Bureau of Soils, 3; States Relations Service, 69; Division of Publications, 646; Office of Public Roads, 16; Bureau of Markets, 183; Federal Horticultural Board, 1. Total, 2,483.

In the photographic laboratory a total of 172,066 pieces were prepared, compared with 127,907 pieces during the preceding year. This increase also is noteworthy, in view of frequent shortage of help in the photographic laboratory.

One hundred and thirty-two requests for photographic work were received from persons outside the department, for which a total of \$405.14 was collected and turned over to the Division of Accounts and Disbursements. A number of photographic pieces were also prepared for the American Red Cross, the necessary material being furnished by that organization.

A large number of cuts used in illustrating the department's publications were taken from the files and sent to electrotypers, who furnished duplicates to the applicants at their expense, these cuts being afterwards returned to the files.

Photographic work done for the different branches of the department and for the public during the fiscal year 1918.

Bureau.	Photo-stat prints.	Contact prints.	Negatives.	Developing.	Lantern slides.	Lantern slides colored.
Office of the Secretary.....	3,704	26,927	151	48	48	.....
Weather Bureau.....		709	57		106	.....
Bureau of Plant Industry.....	5,983	38,606	1,751	3,123	1,684	448
Bureau of Animal Industry.....	99	12,088	1,452	696	3,624	109
Bureau of Chemistry.....		5,749	416	52	684	.....
Bureau of Biological Survey.....	18	11	9		389	16
Bureau of Crop Estimates.....	3,545	34	3			.....
Bureau of Entomology.....	229	5,905	84	22	1,002	.....
Bureau of Soils.....		82		48		.....
States Relations Service.....	146	10,485	820	1,160	11,867	551
Division of Publications.....	49	4,025	249	174	125	.....
Office of Public Roads and Rural Engineering.....						.....
Bureau of Markets.....		18				.....
Library.....	327	34				.....
Federal Horticultural Board.....		105	3	12	12	.....
Paid orders.....		2,017	15		604	.....
American Red Cross.....		2,611	610		1,674	8
Total.....	14,100	109,436	5,620	5,335	21,819	1,132

Bureau.	Bromide enlargements.	Bromide enlargements colored.	Solar bromides.	Maps and prints mounted.	Transparencies made and colored.	Photomicrographs.	Total.
Office of the Secretary.....	847		57	1,217	9		33,008
Weather Bureau.....	92						964
Bureau of Plant Industry.....	200	33	525	378	17	35	52,783
Bureau of Animal Industry.....	639	2		1,233	66	8	20,046
Bureau of Chemistry.....	160		6	1,519			8,586
Bureau of Biological Survey.....	8			8			459
Bureau of Crop Estimates.....	12		433	148			4,175
Bureau of Entomology.....				26		36	7,304
Bureau of Soils.....							130
States Relations Service.....	148		44	148			25,369
Division of Publications.....	7		43	6,254			10,926
Office of Public Roads and Rural Engineering.....			175				175
Bureau of Markets.....			32	12			62
Library.....							361
Federal Horticultural Board.....							132
Paid orders.....	17						2,683
American Red Cross.....	17						4,903
Total.....	2,130	35	1,315	10,973	92	79	172,066

Much of the time of the artist-draftsmen and photographers was occupied in preparing illustrations for war emergency publications. This work included designing special cover pages, making colored drawings for posters, and working over photographs with brush and pen. The amount of such work was greater and it called for greater artistic ability than in any previous year.

MOTION-PICTURE ACTIVITIES.

Prior to the fiscal year 1918 the motion-picture work was experimental, and no definite allotment of funds was made for its support, but for 1918 Congress granted \$10,000 to be used for motion pictures. This made possible the publication on the motion-picture screen of the more important lessons and urgent appeals which the department found it necessary to place before farmers and the general public and enabled the department soon after our entrance into the war to direct the motion-picture work toward the stimulating of agricultural production and food conservation.

The direction of the motion-picture activities, which hitherto had rested in the committee on motion-picture activities, was placed in the hands of Mr. Don Carlos Ellis, in the office of the Assistant Secretary in charge of publications, the committee continuing as an advisory body to preserve intimate contact with the various bureaus.

FILM PRODUCTION.

The motion-picture laboratory has produced for the use of this department 52,250 feet of negative and 104,075 feet of positive film, and for other Government agencies, 36,350 negative feet and 39,375 positive feet. Pictures were made of the following subjects:

Concrete Silo Construction.
 Transfer of Cattle from Drought Stricken Areas to the Corn Belt.
 Control of Pink Bollworm of Cotton.
 Pythian Disease of Potatoes.
 Game on the Wichita National Forest.
 Control of Smut in Oats.
 Lumbering Yellow Pine for Ship Building and the Construction of Wooden Ships.
 Municipal Markets.
 Poultry Selection.
 Meeting the Farm Labor Situation.
 Shoe Leather Investigation.
 The Manufacture and Use of Cottage Cheese.
 Home Drying of Fruits and Vegetables.

FILM DISTRIBUTION.

On June 30, 1918, 51 reels of film, on the following subjects, were available for exhibition:

	Reels.
Grazing Industry on the National Forests.....	1
National Forests as Recreation Grounds and "Bull Run," Portland's Water Supply.....	1
What a Careless Hunter Can Do.....	1
Work of a Forest Fire Ranger.....	1
Tree Planting on the National Forests.....	1
Lumbering Yellow Pine in the Southwest.....	1
Lodgepole Pine for Railroad Ties.....	1
Work of Forest Products Laboratory at Madison, Wis.....	1
Lumbering Lodgepole Pine.....	1
Types of Horses, Washington Horse Show.....	2
Constructing a Concrete Silo.....	1
Uncle Sam's Pig Club Work.....	1
Cooperative Cow Testing.....	1
Government Poultry Farm.....	4
Wool from Sheep to Cloth.....	3
Lambs from Range to Market.....	1
Construction of a Wooden Hoop Silo.....	1

	Reels.
Why Eat Cottage Cheese?.....	2
Cooperative Berry Growing in Pacific Northwest.....	2
Cotton.....	7
Testing Rock to Determine Its Value for Road Building.....	1
Road Construction and Maintenance and Road Tests with Traction Dynamometer.....	1
Cement and Concrete Tests.....	1
Gravel Road Construction.....	1
Macadam Road Construction.....	1
Concrete Road Construction.....	1
Bituminous Macadam Road Construction.....	1
Helping the Farmers of To-morrow.....	2
Congressional Seed Distribution.....	1
Strawberry Industry in Kentucky and Bridge Grafting on Trees.....	1
Dust Explosions.....	1
Preventing Spread of the Gipsy and Brown-Tail Moths.....	4

Of these the equivalent of 350 reels were shown about 1,000 times to about a half million people by representatives of the department. They were exhibited at field and demonstration meetings, municipal gatherings, schools, churches, expositions, county and State fairs, and in motion-picture theaters. In addition to this educational distribution, a large commercial film manufacturing and distributing company made 15 releases in its screen magazine of abridgments of these films, as follows:

Work of a Forest Ranger.	Government Poultry Farm.
Uncle Sam's Pig Club Work.	Strawberry Industry in Kentucky.
Bituminous Macadam Road Construction.	Tree Planting on National Forests.
Sheep Grazing on National Forests.	Egg Embryology.
Types of Horses at Washington Horse Show.	Trap Nest Work.
What a Careless Hunter Can Do.	Lodgepole Pine for Railroad Ties.
Logging Lodgepole Pine.	Cooperative Berry Growing.
	Cooperative Berry Canning.

At least 30 copies of these films were distributed to motion-picture theaters. They were shown at about 700 theaters to approximately 4,000,000 people.

For the use of our negative the department received six reels of each film from which a release was made and in addition paid into the Treasury 10 cents per foot of negative used.

COOPERATION WITH OTHER GOVERNMENT AGENCIES.

The motion-picture laboratory was used by the Division of Films of the Committee on Public Information in conjunction with the force of this department for a period of about eight months. Nineteen reels of negative were loaned to the Committee on Public Information for the making of prints for use in this country and abroad.

The laboratory of this department has made, developed, and printed films for the Alaska Railroad Commission, the Coast Guard Service, the Government Exhibit Board, the Signal Corps and Medical Corps of the Army, and the Bureau of Mines.

SPECIAL CAMPAIGNS.

Four major campaigns were conducted through motion-picture theaters during the year as follows:

Eight thousand lantern slides dealing with the preservation of perishable fruits and vegetables were distributed for use in 2,000 motion-picture theaters in the States of Massachusetts, Pennsylvania,

New York and New Jersey, where reports received by the department indicated that there was danger of loss of a large amount of such perishables.

The Forest Service conducted a forest fire prevention campaign through motion pictures in California, in cooperation with State agencies and a private film corporation.

Eight commercial motion-picture weekly reels carried special pictures regarding the production of back-yard poultry, together with trailers urging that more poultry be raised as a war measure.

The largest campaign dealt with farm labor. The eight weeklies referred to carried news pictures, animated cartoons, and trailers from March until midsummer making appeals for the enlisting in farm work of people from the cities. Many other commercial films also carried trailers on this subject. While it is impossible to measure the effect of these efforts, it is known that millions of people were reached thereby and that much farm labor was recruited as a direct result. The motion-picture companies and theaters have given the department valuable cooperation in placing information and appeals of emergency character before the public.

DOCUMENT SECTION.

DISTRIBUTION OF PUBLICATIONS.

The document section, in charge of Mr. Francis J. P. Cleary, directs the distribution of the bulletins, reports, documents, circulars, leaflets, posters, etc., issued by the department. The actual mailing of the publications is done at the office of the Superintendent of Documents, Government Printing Office, except in the case of emergency publications requiring immediate issuance, which are sent out from the document section. On account of the great increase in the number and variety of printed documents, including war-emergency circulars, etc., the work of the section far exceeded that of any previous year.

On July 1, 1917, there were on hand 7,739,738 publications of all classes, including those at the department. During the year ended June 30, 1918, 92,954,011 publications were received, which, together with the stock on hand at the beginning of the fiscal year, made available 100,693,749 publications, to which may be added press notices and lists of Farmers' Bulletins, numbering 10,786,562, making a grand total of 111,480,311 publications available for distribution.

Of the number available for distribution 99,222,321 were distributed, as follows:

Publications distributed.

Miscellaneous publications.....	65, 298, 266
Farmers' Bulletins.....	23, 137, 529
Lists of Farmers' Bulletins.....	8, 900, 000
Press notices.....	1, 886, 526

On July 1, 1918, there remained on hand 12,184,304 publications, not including press notices and lists of Farmers' Bulletins, divided into 1,768,915 of the miscellaneous class and 10,415,389 Farmers' Bulletins. Included in the miscellaneous distribution were the regular annual publications, the divisional serial publications, and publications in the nature of emergency leaflets, circulars, and posters.

The 23,137,529 Farmers' Bulletins were distributed under the following heads:

Farmers' Bulletin distribution.

Congressional distribution.....	9, 098, 482
Filling the original schemes of distribution.....	977, 000
Filling orders from divisions in the department and from State agents.....	7, 365, 198
Miscellaneous applicants.....	5, 696, 849

This enormous distribution—the largest in the history of the department—involved a great amount of clerical and manual labor. A record was kept with each individual publication. As more than 4,000 individual publications are carried in stock at present, this was a work of great magnitude. Owing to the fact that there are many series of department publications, and many pamphlets fall in a class between circulars and “jobs,” exceedingly close application is required to keep this record accurately. These records often furnish information for the bureaus in the department when contemplating some particular distribution of publications, and they also furnish data to the Office of Information for the distribution of press stories.

CONGRESSIONAL DISTRIBUTION.

A part of the record keeping includes a stock record kept with each Farmers' Bulletin; also an account with each Senator, Representative, and Delegate in Congress. The first-mentioned record is the basis for ordering reprints for the purpose of restocking and the latter to inform Members of Congress of the state of their allotments.

In connection with the congressional distribution, 45,557 letters were received during the year, and in complying with the requests contained therein 43,673 orders were issued on the Office of the Superintendent of Documents, calling for 9,098,482 Farmers' Bulletins, which were sent to persons residing in different parts of the country. In many cases the selection of Farmers' Bulletins is left to the document section. There are rush periods of this class of work, and at such times the force assigned to it is required to work exceedingly hard to keep from falling in arrears. It is hoped that the appropriation providing for emergency labor will relieve this situation to a great extent.

MISCELLANEOUS DISTRIBUTION.

Several thousand requests for publications are received daily from miscellaneous applicants in different parts of the country. These requests are largely due to the Monthly List of Publications, which is mailed to approximately 200,000 persons each month. The classification of these letters and the making of orders for the mailing of publications, which are sent from the office of the Superintendent of Documents, require the best efforts of a correspondence unit composed of 30 clerks, in charge of Mr. John O. Riley. Within the last fiscal year 762,744 communications requesting publications and other information were received. In complying with these requests 729,520 orders were issued on the Superintendent of Documents.

All communications were acknowledged either by sending the publication requested, by form or postal card stating why the publication could not be sent, or by quoting the price at which it could be purchased from the Superintendent of Documents, Government Printing Office.

There is a distinct rush season in the handling of miscellaneous mail—from January to April each year. The volume of mail received during that time is greater than in any other period of the year, and during such time it is difficult to keep the work up to date with the regular force. This is the reason that an additional appropriation of \$2,500 for additional labor was requested for the next fiscal year. With this fund available it is believed that there will be no difficulty in keeping the work up to date during the present year.

Probably because of prompt and careful attention to all requests received from miscellaneous applicants, a considerable constituency has developed, composed of correspondents who incorporate in letters requests other than for publications. It was therefore necessary during the year to refer 48,444 such communications to other bureaus.

The keeping of an index of the names of individuals to whom the Yearbook is sent is also assigned to the correspondence unit, and 27,000 entries were made for the Yearbook for 1917. The correspondence unit also furnishes publications and information to constituents of Members of Congress upon requests from such officials.

Much information is furnished to correspondents in the form of written communications, in addition to the regular form communication in use. During the year 75,116 typewritten communications were prepared and mailed. This number was considerably less than the number for the preceding fiscal year, principally because during the last quarter of the year the typewritten letters to Members of Congress were greatly reduced by the use of forms. The time thus saved was used in cutting stencils for mimeograph work, principally for the Office of Information. During the quarter mentioned, 284 such stencils were cut.

WORK OF THE MACHINE ROOM.

The labor-saving machine unit contains addressing, duplicating, paper-cutting, folding, and pad-making machines, with which a very large amount of work was done, part of it cooperative service for 21 different branches of the department. During the year 1,413 jobs of duplicating work were done, totaling 3,754,366 copies and requiring 5,767,692 impressions. The work involved the assembling of 2,490,364 pages and the stapling of 190,268 sheets of paper. Mailing lists maintained here contain 250,789 addresses. For these lists stencils were cut for 52,932 new addresses, and 29,440 stencils were removed from the files. At present about 200 different mailing lists are maintained in this office, controlled by 16 divisions in the department.

Franks and envelopes numbering 6,772,398 were addressed on the addressing machines during the year; 307,452 congressional franks furnished to this office in sheets were cut, besides 1,616,418 sheets

of paper furnished by other branches of the department; 13,535 pads were made and distributed to offices desiring them, and 2,037,612 circulars were folded on the folding machine.

The machine room continues in charge of Mr. C. E. Bracey.

WORK OF THE FOLDING ROOM.

Probably no other class of work in the Division of Publications has increased in the same proportion as the work of the folding room, which was more than 100 per cent greater than during the preceding year. This increase was due to the great number of emergency publications issued in connection with the department's campaign to stimulate agriculture and conserve food.

MAILING LIST RECORD WORK.

Closely related to the mailing and folding work is that of the mailing list records maintained by the Division of Publications at the office of the Superintendent of Documents, Government Printing Office. These stenciled addresses comprise 281 individual mailing lists, each mailing list being controlled by the bureau, office, or division creating it, this division acting as a medium. This work includes the typewriting and alphabetizing of cards, indexing, and the general index of addresses.

In addition to the mailing-list record work, the force assigned to it cooperated with other offices in the department by writing 165,328 addresses to which publications were mailed.

FOREIGN MAIL.

During the last fiscal year 59,681 packages, weighing 24,110 pounds 2 ounces and requiring an expenditure of \$1,928.81, were mailed from this division, while 3,543 packages, weighing 1,613 pounds 1½ ounces, at a cost of \$80.66, were sent through the Smithsonian Exchange, bringing the total cost up to \$2,009.47.

RECEIVING AND DISTRIBUTING JOB WORK.

The work of receiving and distributing job work coming both from the Government Printing Office and from private printers is steadily increasing. Approximately 60,000,000 copies of the various blank forms used throughout the department were received and forwarded.

PERSONNEL.

Members of the force engaged in distribution worked exceedingly well and very faithfully indeed during the year. The spirit shown was excellent. The work was hampered to a considerable degree by the loss of 70 employees during the year.

REPORT OF THE CHIEF OF THE BUREAU OF CROP ESTIMATES.

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF CROP ESTIMATES,
Washington, D. C., October 1, 1918.

SIR: I have the honor to submit herewith the report of the Bureau of Crop Estimates for the fiscal year ended June 30, 1918.

Respectfully,

LEON M. ESTABROOK,
Chief of Bureau.

Hon. D. F. HOUSTON,
Secretary of Agriculture.

ADMINISTRATIVE OFFICE.

The entrance of the United States into the war has given new significance to the functions of the Bureau of Crop Estimates. The responsibility laid upon this Nation not only of feeding itself and the Allies, but to do so with less than a normal number of agricultural workers, has made it necessary to know more promptly and more in detail than ever before the present conditions and future prospects of the important food crops.

The organization of the bureau was such that with a comparatively small increase in force it was possible not only to issue the regular reports, but to supply the very large amount of special information desired by officials of the Department of Agriculture, of the Food Administration, and others.

An instance of this was the so-called food survey made as of December 31, 1917. More than 500,000 inquiries designed to secure special information relative to food conditions at the close of that year were mailed in December. A portion of the returns were sent to the field agents for tabulation; the bulk of them, however, were handled in the Washington office. That portion of the inquiry relating to live stock was tabulated and printed in the February issue of the Monthly Crop Report and the remainder appeared in the May issue. All of the information was fully tabulated and available to the department heads and the Food Administration officials at even earlier dates. These and other important results in addition to the regular work of the bureau have been obtained with little or no outward indications of the extra work accomplished.

One source of anxiety to the administrative office is the lack of adequate working space in Washington. It was considered that the space available to the bureau was fully utilized prior to the increase in force. With that increase, however, has come no increase in space, so that the performance of the work is difficult and the conditions in

some offices decidedly unsanitary. Effective centralization of the mechanical work of the bureau is impossible under present conditions.

Owing to the shortage of space the necessary stocks of paper, envelopes, and printed forms are scattered among four widely separated storage places. No one of these spaces, nor all of them combined, is adequate for the purpose. They permit neither sufficient storage space for the material necessary to our work nor efficiency in the receiving, recording, and issuance of supplies. It is hoped that sufficient space will become available eventually, so that this important branch of the work may be conducted with businesslike efficiency and economy.

The salary conditions in the Bureau of Crop Estimates will be made the subject of recommendation in connection with the estimates for the fiscal year 1920. They represent a factor in the difficulty experienced by the Bureau of Crop Estimates since the entrance of the United States into the war which should be mentioned at this time.

It seems absolutely necessary in the interest of justice and efficiency to eliminate the \$900 grade for clerks. It is becoming more and more difficult to fill vacancies in that grade, and in order to maintain a working force we are obliged in most cases to offer entrance salaries of from \$1,000 to \$1,200, payable from lump sums available to the bureau. At the same time we have many experienced clerks at \$900 to \$1,000 on the statutory roll who are barred from promotion by the lack of vacancies in the grades above and from transfer to better paying positions elsewhere by law. This creates a situation whereby new and untrained clerks are paid higher salaries than many whose experience renders them almost indispensable to the service, from whom the newcomers receive much of their instruction, and whose fixed salary becomes a relative demotion by reason of the increased cost of living. The new employees brought in at higher salaries likewise become eligible for positions in the higher grades, for which the older clerks in grades below can not be considered. The growing dissatisfaction and discontent produced by these conditions has had a detrimental influence upon the work of the bureau. The work of the truck-crop section has had to be curtailed because of the excessive number of resignations.

Adequate recognition has not been given to the service rendered by the clerks of the bureau. The bulk of the work of the Bureau of Crop Estimates is of a skilled clerical nature, requiring the highest ability in tabulating, computing, and statistical research. It is considered that we have one of the best forces of computers to be found, in proof of which may be cited the fact that they have repeatedly outdistanced the best adding-machine operators that could be brought together for competition with them. This point is especially significant when it is remembered that the average salary paid to statutory clerks in the Bureau of Crop Estimates during the fiscal year 1917 was only \$1,192.47.

The work on which the tabulating and computing clerks are engaged is, at crop report time, of the most grueling nature, and calls for sustained effort and intense concentration for a period of about eight days, during which no account is taken of holidays, and oftentimes none of Sundays. This results from the fact that the law requires crop reports to be issued at a specified time, and every other

consideration must give way to completing the tabulation. Similarly, the statistical-research clerks have acquired a familiarity with the statistical data of all nations and an ability in the treatment of international agricultural statistics not indicated by their titles nor, in many cases, recognized in the way of salary.

The need of civil pensions has long been felt in the Bureau of Crop Estimates. A proper pensioning system is not only desirable from a humane standpoint, but would be in accordance with sound business policy long since recognized in the commercial world.

COOPERATION WITH THE CENSUS BUREAU.

During the past year this bureau has cooperated with the Bureau of the Census in the preparation of the schedules for the agricultural census, to be taken January 1, 1920. Fifty thousand tentative schedules were "tried out" on the crop reporters of this bureau with good results. The 1920 census schedule will omit questions of value of crops, as the Bureau of Crop Estimates will be depended upon for this information; this will cause a saving of nearly 20 per cent in the number of items called for and to be tabulated.

FIELD SERVICE.

From an administrative as well as from a service standpoint the greatest advances made by the bureau occurred in the field. These advances were along two lines—internal improvements in the field organization, equipment, and methods, and the establishment of cooperative relations with crop-reporting services existing in several of the States.

As to the internal improvements:

Formerly the field agents with few exceptions maintained their offices in their homes. Their equipment consisted of a few filing cases and a typewriter. They made their own tabulations, wrote their own letters, and performed all other necessary office work without assistance, except such as might be rendered voluntarily by members of their families. In a very few cases offices were maintained in Federal buildings. The necessary travel kept the field men away from their homes the greater portion of the month, so that upon their return they were confronted by accumulations of work consisting of correspondence, filing, opening, and tabulating returns, preparing their crop report, and inclosing and mailing hundreds of schedules relating to the succeeding month's report. This has always involved an enormous amount of work for one man to handle. On more than one occasion field agents have worked from sunrise to sunrise without stopping for rest, and on some occasions 18 hours a day for several days in succession. The average hours of labor in the field during the period when the men are at their headquarters is probably in excess of 12, Sundays included.

In this connection it should be said that the spirit of the men in accepting work days of 10 to 14 hours and more as a matter of course, and without complaint, is a striking testimonial of their devotion to duty and loyalty to the service.

But the necessity for securing quickly reliable reports along special lines, and the appropriation of funds for that purpose, have made possible immediate improvements in the service. The efforts along

this line have been directed to replacing inefficient agents with those possessing demonstrated ability; establishing offices in suitable office buildings; installing telephone, and other time-saving equipment; and employing clerks. Every field agent now has a mimeograph, an addressing machine, and an envelope sealer. Many of them have adding machines, and three have folding machines. Nearly all of them now have clerks. It formerly was the practice to do all of the addressing and duplicating work in Washington. Under present conditions, however, the field man is able not only to relieve the Washington office of much of the burden formerly carried in connection with regular reports, but to make promptly general or restricted special investigations, either upon its own initiative or upon telegraphic request from Washington.

An outgrowth of the improved equipment is the publication by field agents of crop reports, each for his own territory. Immediately upon issuance of a crop report in Washington the United States figures are telegraphed to each agent, together with figures for his particular territory. He immediately issues a mimeographed report with comments on crop and weather conditions in his State, copies of which are furnished to the press and to the crop reporters.

The agents of some of the States are now issuing reports on a county basis, and these especially are winning warm approbation. Many of the metropolitan dailies publish these reports in full, in some instances giving first-page space to them. It has been planned, and a beginning made, for each agent to send his State reports to his own list of aids and to the county and township reporters, who have already shown great interest in them, but difficulties of the situation with regard to paper and envelopes threaten to curtail this distribution.

During the year several meetings of groups of field agents were held at convenient points for purposes of instruction by representatives from the administrative office and for discussion of problems in crop estimating common to groups of States. One such meeting was held at Atlanta, Ga., in February, at which were present all field agents from the cotton States. Another was held in Chicago last April, of field agents from Iowa and the corn belt States east of the Mississippi, including Wisconsin. A third meeting was held at Lincoln, Nebr., in July, of field agents from the Mississippi to the Rocky Mountains and from Missouri and Kansas northward to the Canadian boundary. These meetings have proved very helpful in solving special problems, in stimulating interest, in bringing about better and more uniform methods, and in developing plans for improved service.

As to cooperation:

Formal cooperative agreements have been entered into with the State departments of agriculture in Wisconsin, Utah, Nebraska, and Missouri. Informal cooperative relations have been established with the College of Agriculture of Cornell University in New York. The results have been so satisfactory that extension of this plan in other States is contemplated.

The objects sought are:

(1) To obviate duplication of effort; (2) to permit the combined agencies to secure fuller information concerning the subjects under investigation; (3) to permit the consideration and adequate study

of agricultural subjects which are important in individual States, but not important in the United States as a whole; (4) to assure the essential feature of comparability in the State statistics for successive years by introducing the permanency of methods and routine of the Federal bureau; and to assure the good will and cooperation of State agencies in developing an invaluable body of State statistics of agriculture; (5) to place at the service of the State in the collection and study of agricultural statistics the resources, experience, and statistical training of the Federal bureau; (6) to make accessible to the Federal bureau the extensive classified lists maintained by the various State departments, particularly of those engaged in agricultural work; (7) to afford additional channels for the dissemination of the information collected; (8) to secure public confidence in the reports issued, both because of their greater absolute accuracy as a result of combining efforts, and through the discontinuance of conflicting estimates, which, however much they may both merit confidence or by their close agreement prove their substantial accuracy, cause confusion, and are viewed with suspicion by many because they are not in exact agreement. This suspicion is greatest and most hurtful in the case of producers, who do not appreciate the difficulties of preparing crop estimates and the relative insignificance of considerable absolute deviations.

DIVISION OF CROP REPORTS.

The work of the Division of Crop Reports, under the direct supervision of Mr. Edward Crane, consists of securing and maintaining a list of approximately 199,384 voluntary crop reporters, to whom schedules of inquiry regarding crop and live-stock conditions are forwarded periodically. When these schedules are returned they are tabulated and averaged. The data collected and compiled by this division, supplemented by reports from the field service, constitute the basis of the monthly and special crop reports of the bureau.

Voluntary crop reporters.

List.	1918	1917	List.	1918	1917
Township.....	33,743	31,338	Maple sirup.....	2,017	1,716
County.....	2,752	2,792	Truck.....	13,600	13,600
County aids (estimated).....	5,504	5,586	Apple.....	11,000	8,238
Field aids.....	20,180	15,843	Peach.....	3,500	.....
Special price.....	6,408	6,051	Rice.....	500	.....
Live stock.....	8,689	10,860	Tobacco.....	900	.....
Mill and elevator.....	11,684	13,351	Cranberry.....	.....	365
Individual farm.....	50,000	42,201	Peanut.....	.....	4,351
Special cotton.....	5,640	5,464	Comparative price.....	.....	796
Cotton special list.....	857	857	Broom corn.....	.....	1,040
Honey bee.....	5,964	3,995			
Potato.....	10,000	4,067			
Sheep.....	6,446	6,445			
			Total ¹	199,384	178,957

¹ Does not include special lists maintained by field agents.

While the fiscal year 1917 showed an increase of 50 per cent over 1916 in the total number of inquiries sent out from the division, the fiscal year 1918 shows a still further increase over 1917 of 56 per cent, with 3,200,909 schedules forwarded.

The number of schedules mailed out naturally increased proportionately the amount of material to be tabulated and compiled. The

availability of the various lists of voluntary reporters in the field, and the specially trained force of statistical clerks in the office, made it possible to obtain at short notice and at nominal expense timely information as to the amount of foodstuffs on farms (emergency food survey), the farm labor and fertilizer situation, localities of excess and deficient seed supplies, and binder-twine requirements, in addition to the regularly prepared monthly estimates as to the condition, quality, acreage, yield per acre, and production of various crops, and number and condition of live stock on farms, as well as the price paid the farmer for his products. All of the above information has a distinct bearing on the present international situation.

The number of graphic maps showing the distribution of various crops according to acreage and production prepared during the fiscal year was 189.

DIVISION OF TRUCK CROPS.

During the year approximately 133 inquiries were made as compared with 100 last year, an increase of 33 per cent; of this number 22, monthly and bimonthly, covered the condition of truck; 8, monthly and bimonthly, condition of truck grown for manufacture; 4, monthly, condition of truck grown in market gardens; 5, celery; 2, strawberries; 8, acreage contracted of corn, tomatoes, peas, beans; 6, tomatoes; 5, watermelons; 5, cantaloupes; 2, cauliflower; 1, kraut; 2, peppers; 2, kale; 3, spinach; 2, radishes; 1, parsnips; 2, acreage contracted of cabbage; 7, cabbages; 9, onions; 3, seeds; 4, cucumbers; 4, lettuce; 1, pumpkins; 2, carrots; 2, beets; 2, turnips; 1, squash; 2, garlic; 1, parsley; 2, eggplants; 2, asparagus; 1, early Irish potatoes; 1, beans; 1, peas; and 6, miscellaneous. The foregoing inquiries covered condition, acreage, dates of planting and harvesting, yield per acre, price paid to growers, per cent stored, per cent abandoned, per cent shipped out of county, per cent consumed on farms, etc. Beginning in October, 1917, bimonthly inquiries were made regarding the condition of truck, and beginning in May inquiries were made regarding the condition of market-garden truck. An inquiry was also made concerning the acreage of truck grown in market gardens.

NUMBER AND SCOPE OF REPORTS.

Beginning with the issue for the week ending December 8, 1917, a weekly report giving timely information concerning acreage, condition, and production of truck was issued. This report, known as the Weekly Truck Crop News, has been enthusiastically received by growers of and dealers in truck. During the year approximately 134 reports were published as compared with 65 in 1917, an increase of about 106 per cent; of this number 28 constituted the Weekly Truck Crop News; 15 covered monthly and bimonthly condition of truck; 4, condition of truck grown for manufacture; 13, cabbages; 13, onions; 6, early Irish potatoes; 2, watermelons; 1, cantaloupes; 5, each, acreage contracted of tomatoes and peas; 4, acreage contracted of corn; 2, each, acreage contracted of cabbages and beans; 3, celery; 4, tomatoes for shipment; 3, lettuce; 1, cauliflower; 1, brocolli; 6, Bermuda onions; 2, cucumbers; 1, peppers; 2, strawberries; 1, spinach; 1, green beans; 1, seeds; and 8, miscellaneous. Special notes were made concerning market-garden truck in the Weekly Truck Crop News.

COMPILATION OF LISTS.

On July 1, 1918, approximately 13,300 correspondents were on the list of this section as compared with 14,000 on July 1, 1917, a decrease of about 5 per cent. This decrease is due to a cleaning out of the lists during the past year of "dead" correspondents.

MAIL HANDLED.

In the past year 145,157 pieces of mail matter were sent from this section, as compared with 109,449 pieces during 1917—an increase of about 32 per cent. This includes the extra addressing of envelopes, correspondence, miscellaneous inquiries, etc., and does not include the schedules or reports sent in addressed envelopes furnished by the Division of Publications. The record by months is as follows: July, 6,217; August, 5,991; September, 3,311; October, 3,783; November, 8,638; December, 6,599; January, 6,154; February, 9,694; March, 18,481; April, 23,519; May, 23,473; June, 29,297; total, 145,157. In addition to the foregoing a large amount of incoming mail matter was tabulated, sorted, and filed for future reference.

ORGANIZATION.

On July 1, 1918, the organization of this section consisted of 3 assistant truck-crop specialists; 1 assistant to the specialist; 1 temporary stenographer; 7 permanent clerks, 2 temporary clerks; 2 one-half time clerks; and 1 messenger. During the year, in addition to the personnel on July 1, 1917, 17 new clerks were assigned to this section, and of these 14 resigned, were transferred to other bureaus, or their appointments were terminated, being temporary. In a bill now before Congress, 2 additional assistant truck-crop specialists are provided for, and an examination for eligibles was held on August 21 and 22, 1918, 13 candidates appearing. In this bill provision is also made for the employment of 25 correspondents to report weekly on the truck-crop situation.

TRAVEL.

The three assistant truck-crop specialists have made extensive trips over their territory, gathering information concerning truck crops. In addition to the foregoing travel, one trip to Ohio, Indiana, and Wisconsin, one to Massachusetts, three to Texas, one to Florida, one to California, and two to Norfolk were made by the truck-crop specialist, as well as two trips to Virginia and Maryland by his assistant.

MISCELLANEOUS.

A large amount of miscellaneous tabulating, typewriting, filing, etc., which is not indicated in the foregoing, has been done during the year.

SUMMARY.

During the year the number of inquiries made increased 33 per cent and reports published 106 per cent. The number on the lists decreased about 5 per cent. A start was made on the market-garden phase of the truck-crop project and the information collected was published. The Weekly Truck Crop News is improving each week and as soon as additional correspondents are provided for it is expected to enlarge the scope of the report. This work has been hampered in the past

by the lack of a stable organization, many of the clerks being assigned to it for only temporary periods. As an indication of the unstable character of the organization attention is called to the fact that of the eight clerks who were assigned July 1, 1917, at the present date only three remain, although approximately 17 new clerks were assigned during the year.

DIVISION OF CROP RECORDS.

This division, under the direct supervision of Mr. Frank Andrews, chief of division, has charge of the official records of crop estimates concerning the United States from Federal, State, and private sources, and also of agricultural statistics of foreign countries. The records have been compiled from published and unpublished reports in such a way as to show in concise and convenient form information that is given in the original reports in a more or less scattered way, usually in a long series of reports and frequently in foreign units of weight and measure. In every completed office record these units of foreign weight and measure have been converted to the equivalent American units. Statistical records giving acreage and production of crops have been compiled for 27 foreign countries. In addition to the regular compilation of records the foreign crop work has included a large amount of special compilations and correspondence. When the compilation of agricultural statistics for the remaining countries is finished (probably within the next year) the Bureau of Crop Estimates will have one of the most complete records of estimates and statistics relating to world crops and live stock in existence, all expressed in terms of American units and in such convenient form as to be immediately available for reference. Estimates of crop production, as made by State officials and private agencies and individuals, have been segregated and entered on record practically as soon as received in the division.

The special investigations of this division included a comprehensive inquiry as to production compared with supply of principal farm products. Some results of this inquiry relating to wool and hides were given in two articles in the Department Yearbook for 1917, and a bulletin on the production and supply of potatoes was in press at the close of the fiscal year. An inquiry as to geographic variations in prices paid to farmers was completed and the results were given in three reports on wheat, corn, and oats, respectively. The bulletin on wheat prices was published during the year.

Reports on the sugar crops of the United States and Hawaii are compiled in this division. These reports are based upon actual enumerations, and in this respect are an exception to the general crop-reporting system of the bureau. During the year three reports were made relating to beets and beet sugar—namely, acreage planted, preliminary estimate of beets produced and sugar made, and after the close of the season a final estimate of beet and sugar production. There was also made, in December, the second annual estimate of this bureau on the acreage and production of sugar-beet seed. Three reports were made on the Louisiana sugar industry; one in December, giving the estimated tonnage of cane to be used for sugar; one in January, giving a preliminary estimate of the sugar made; and a final report in May, giving the annual production of sugar, as well as the tonnage and acreage of cane used. One report was made for

the Hawaiian industry, giving the final figures for acreage and production of cane and the production of cane sugar. The third annual report on maple sugar and sirup was planned and completed in this division.

A large number of statistical compilations were made for the Secretary, the Assistant Secretaries, other Government officials, and other persons interested in agricultural statistics. Food production and supply in the United States and foreign countries was a frequent subject of inquiry.

In order to furnish data as promptly as possible, a series of office tables, with duplicate copies, is maintained. These tables number over 460 and cover subjects for which there is likely to be a demand and which relate to crop estimates.

BUREAU LIBRARY.

The library of the Bureau of Crop Estimates, which is a branch of the library of the department, during the fiscal year received approximately 192 foreign and 294 domestic periodicals containing useful information regarding agricultural statistics. Of these periodicals about 164 were monthly, 118 weekly, 40 daily, and the remainder were issued at other periods. The foreign periodicals received were about 58 less than in the fiscal year 1917—a decrease owing to war conditions.

The books in the library comprise the agricultural reports of practically all countries issuing such reports; also a fairly complete collection of the official reports of exports and imports for each foreign country. The collection of State reports on agriculture and live stock is practically complete; also annual statistical reports of commercial agencies, such as boards of trade, chambers of commerce, cotton exchanges, etc.

Constant use has been made of the books and periodicals, also of the working space provided here for investigators from outside the bureau. A large amount of research work was done in this library during the year by persons connected with other branches of this department, with the Food Administration, War Trade Board, Federal Trade Commission, Tariff Commission, Shipping Board, and Committee on Public Information.

INTERNATIONAL INSTITUTE OF AGRICULTURE.

Monthly reports on crops and on exports and imports of cereals and cotton, also various data on other agricultural subjects, were sent by mail, cable, and radiogram to the International Institute of Agriculture, Rome, Italy. In addition to the International Crop Report, the Institute's Yearbooks, and other printed matter, 14 cablegrams relating to crops in various countries were received from the Institute.

FRUIT CROP ESTIMATES.

The special Fruit Crop Estimating Service is now well organized, with three fruit crop specialists engaged in field work, one statistical clerk in charge of office work, and additional clerical assistants at Washington. This service has undertaken the work of issuing regular reports giving accurate forecasts of the amounts of different fruits

which may be expected to reach commercial channels. Cooperative relations have been established with leading growers and shipping associations in all parts of the country for the purpose of collecting and disseminating this information, which is of vital importance to producers and consumers of commercial fruits. During the fiscal year 1918 complete surveys were made of practically every important apple and peach producing county in the United States.

Apple and peach forecasts giving detailed estimates by States and regions, together with complete comments upon the growing conditions in all parts of the country, are now being issued monthly, and it is planned to extend this service to other fruits. Approximately 10,000 voluntary apple reporters and 4,000 peach reporters are included in the special lists of correspondents reporting to this office.

The total crops included in this work had a value in 1917 of \$274,143,000.

PUBLICATIONS.

Twelve numbers of the Monthly Crop Report were issued during the year, aggregating 136 quarto pages of estimates and agricultural statistics.

Two hundred and nine statistical tables were prepared for publication in the department Yearbook for 1917.

The following Department Bulletins were published: No. 594, Geography of Wheat Prices. No. 685, Honeybees and Honey Production in the United States.

Three articles were contributed to the Department Yearbook for 1917 on (1) Wool: Production, Foreign Trade, Supply, and Consumption; (2) Hides and Skins: Production, Foreign Trade, Supply, and Consumption; and (3) Sugar Supply of the United States.

The following Department Bulletin was in press at the close of the fiscal year 1918: Potatoes: Acreage, Production, Foreign Trade, Supply, and Consumption, by George K. Holmes.

MONTHLY CROP REPORTS.

During the year the bureau issued estimates of the numbers, prices, and value of different classes of live stock, losses from disease and exposure, number of breeding sows, and the number of stock hogs compared with last year.

Acreage estimates were made in June for barley, oats, spring wheat, alfalfa hay, clover hay; in July for corn, rice, kafirs, timothy hay, potatoes, sweet potatoes, beans (dry), cotton, flaxseed, sorghum cane, tobacco, broom corn, hops, peanuts; in August for buckwheat, hay, (tame hay, wild hay, and total); in September for clover seed; and in December for rye and winter wheat. Acreage remaining after abandonment was estimated for winter wheat and rye in May and for cotton in December.

Monthly during the crop season estimates were made of the condition of the growing crops as a percentage of normal for cereals, including barley, buckwheat, corn, oats, rice, rye, wheat (spring and winter); forage, including alfalfa hay, alfalfa for seed, bluegrass for seed, field beans, field peas, clover for hay, clover for seed, hay (tame hay, wild hay, and total), kafirs, millet, pasture, and timothy hay;

fruits, including apples, apricots, blackberries and raspberries, cantaloupes, cherries, cranberries, figs, grapefruit, grapes, lemons, limes, olives, oranges, peaches, pears, pineapples, plums, prunes, and watermelons; vegetables, including lima beans, cabbage, cauliflower, celery, onions, potatoes, sweet potatoes, and tomatoes; miscellaneous, including almonds, broom corn, cotton, flaxseed, hemp, hops, peanuts, percentage of planting done, percentage of plowing done, sorghum cane, sugar beets, sugar cane, tobacco, English walnuts, and wool.

Yield per acre was estimated in December for all principal crops for which acreage estimates were made. During the growing season the condition reports, expressed as a percentage of normal for all crops for which acreage is estimated, were interpreted in yield per acre as a forecast of production.

The percentage of a full crop produced was estimated in April for celery in California; in May for cauliflower in California; in July for cherries in California; in August for clover hay, blackberries and raspberries, pineapples (Florida); in September for alfalfa hay, bluegrass seed, timothy hay, apricots (California), cantaloupes, peaches, plums (California), watermelons and wool; in October for alfalfa seed, millet (hay and seed), prunes (California), field beans (grain and forage), lima beans (California), cabbage, onions, tomatoes, and broom corn; in November for clover seed, field peas, kafirs, apples, cranberries, figs (California), grapes, pears, almonds (California), peanuts, and English walnuts (California); in December for grapefruit and limes (Florida), lemons and olives (California), and oranges.

Farm prices of all crops and live stock were estimated monthly.

Final estimates of acreage, yield, and total production were made in December for barley, buckwheat, corn, oats, rice, rye, wheat, hay, potatoes, sweet potatoes, flaxseed, cotton, tobacco, broom corn, hemp, kafirs, beans, hops, and cranberries; and of production of apples, peaches, pears, and oranges.

The percentage of the corn crop cut for silage was estimated in November.

The percentage of the crop of merchantable quality was estimated in March for corn.

The percentage of crops shipped out of counties where grown was estimated in March for barley, corn, oats, and wheat.

The quality of crops produced was estimated in August for rye, winter wheat, and clover hay; in September for tame and wild hay and peaches; in October for barley, oats, spring wheat, and hops; in November for buckwheat, corn, apples, cranberries, grapes, pears, potatoes, sweet potatoes, flaxseed, peanuts, and tobacco; in December for grapefruit and limes (Florida), lemons (California), and oranges.

Supplies on farms were estimated in March for barley, corn, oats, and wheat; in May for hay; in July for wheat; in August for barley and oats; and in November for corn.

The weight per fleece was estimated in July for wool; and weight per bushel for barley, oats, and wheat in November.

SPECIAL REPORTS.

Among the special reports published during the year in the Monthly Crop Reports were the following:

- Acres contracted for by canners. August, 1917; June, 1918.
- Apple estimates by varieties. September, 1917.
- Bean varieties. August, 1917.
- Beans, edible, special report. April, 1918.
- Bean and pea acreage for feed. October, 1917.
- Cabbage, special acreage and production reports. September, October, November, 1917.
- Cabbage for kraut. March, 1918.
- Celery crop of California. November, 1918.
- Celery crop of California. November, 1918.
- Cordwood used on farms. January, 1918.
- Corn for seed, deficiency for 1918. March, 1918.
- Corn for seed, tested. June, 1918.
- Corn damaged by frost, special reports. October, November, 1918.
- Corn and hog prices compared. April, 1918.
- Corn, white, yellow, and mixed, production. December, 1917.
- Crop acreages, total by States. May, 1918.
- Crop production, yearly variation, charts. June, 1918.
- Crop production and railroad tonnage compared. July, 1918.
- Crops on farms January 1. May, 1918.
- Crop prices and production. November, 1918.
- Depth of plowing, by States. February, 1918.
- Durum wheat receipts and exports. August, 1918.
- Farmers and farm laborers, 1910. Classified March, 1918.
- Farm labor, how hired. November, 1917; March, 1918.
- Farm products, total value yearly. January, 1918.
- Farms, number, reporting various crops and live stock. May, 1918.
- Fertilizers on cotton. August, 1917.
- Foodstuffs, foreign trade, 1912-1917. March, 1918.
- Food supplies of various countries, index numbers. August, 1917.
- Grain and forage crops in the South, special report. May, 1918.
- Hay crop, per cent baled. October, 1917.
- Hemp acreage, by States. September, 1917.
- Hog marketings monthly. September, 1917.
- Honey crop. September, November, 1917; May, 1918.
- Hop production and consumption. November, 1917.
- Horses and mules, average weight by States. February, 1918.
- Horses, number used per plow, by States. February, 1918.
- Index numbers of crop production, prices and values, eight years. December, 1917.
- Index numbers of prices of farm products. May, 1918.
- Largest crop yields per acre, 1916. January, 1918.
- Leading States in production of staple crops. July, 1918.
- Live stock, total values, by States. February, 1918.
- Live stock, yearly marketings, 1900-1917. February, 1918.
- Live stock in principal countries. February, 1918.
- Live stock, cycle of prices, charts. April, 1918.
- Maple sugar, special report. May, June, 1918.
- Meat and meat animal exports, 1904-1917. February, 1918.
- Onions, commercial acreage and production. September, October, 1917.
- Peach crop, special report. July, 1918.
- Peas, for canneries. March, 1918.
- Plow lands, value per acre. April, 1918.
- Potatoes, stocks January 1. January, 1918.
- Potato forecast, by months of harvest. November, 1918.
- Potatoes, months when disposed of. May, 1918.
- Prices of articles bought by farmers. March, 1918.
- Prices, yearly average, of important products, 10 years. December, 1917.
- Production per man and per acre, in various countries. July, 1918.
- Rice, varieties sown. September, 1917.
- Sheep breeds. April, 1918.
- Silos in the United States. August, 1918.

Strawberries, commercial acreage and production. June, 1918.
Swine losses 1884-1918, chart. April, 1918.
Trend of crop prices, farm wages, and land values, 1909-1917. April, 1918.
Truck crops, winter condition. December, 1917.
Wages of farm labor. March, 1918.
Wheat exports monthly, 1910-1917. March, 1918.
Wheat fed to live stock. March 1918.
Wheat, maximum yield. July, 1918.
Wheat, monthly farm movement. November, 1917; March, 1918.
Wheat prices in England, yearly since 1859. November, 1917.
Wheat prices, monthly, 1910-1917. November, 1917.
Wheat, surplus and deficiency, by States. October, 1917.
Wheat, where held monthly. March, 1917.
When farmers sell their crops. August, 1917.
Winter wheat, acreage planted and harvested yearly. July, 1918.

TRIBUTE TO AMERICAN FARMERS.

Perhaps no branch of the public service is in position to recognize so promptly and appreciate so fully as the Bureau of Crop Estimates what has been accomplished by the farmers of the United States since the breaking out of the world war. From the reports of its thousands of voluntary crop reporters and its field agents who travel over each State and report weekly and monthly their observations, the bureau is in constant touch with the progress of crop production from month to month and year to year. It has seen the supply of farm labor steadily decrease from heavy drafts made upon it by other industries, especially since the beginning of the war, and it has noted the decrease in the supply of commercial fertilizers. It has noted also the steady rise in farm wages, and in prices of farm machinery and everything else that farmers have to buy. With an unbounded faith in the patriotism and determination of farmers to do their utmost to help win the war by maintaining the production of food and raw materials, it nevertheless has marveled that the farmers of the United States apparently have accomplished the impossible by continuing to plant larger areas and to harvest larger crops in the aggregate with each year of the war in spite of the difficulties of securing farm labor, supplies, machinery, and other necessary articles.

The planting and cultivating of 32,000,000 acres more in 1917 than in 1914 by the farmers of this country is comparable with the phenomenal increase in the military forces, or with anything that has been accomplished by any other industry, not excepting the building of ships, or the manufacture of munitions and supplies, for the tremendous increase in agriculture was accomplished with fewer and fewer men, while the other industries constantly increased their man power.

This great achievement of American farmers is not so spectacular nor has it received the same publicity and recognition as the launching of some hundreds of new ships, the manufacture of large quantities of munitions, air planes, and Liberty motors, or the transport of unprecedented numbers of troops overseas, because the preparation of the soil, and the planting, cultivating, and harvesting of crops are slow processes and are not concentrated in time and place under direct observation nor heralded to the people by the press. Nevertheless, this production of food crops on an enlarged scale, at greatly increased expense of time, effort, and labor and by fewer men,

steadily and without publicity or the inspiration that comes from large bodies of men working together, has done as much to insure the winning of the war against the military despotism of Europe as any other one factor.

All the effort that has been made by the Federal Department of Agriculture, by the State colleges of agriculture and experiment stations, and by other State and national agencies since the United States entered the war would have been of no avail without the effective, the efficient and patriotic service of the American farmer. It is the special function of the Bureau of Crop Estimates to record and publish the acreage planted and the crops harvested by the farmers of the United States, and it therefore seems appropriate at this time that the Bureau should record its estimate of their great contribution to the winning of the war.

REPORT OF THE LIBRARIAN.

UNITED STATES DEPARTMENT OF AGRICULTURE,
OFFICE OF THE LIBRARIAN,
Washington, D. C., September 30, 1918.

SIR: I have the honor to submit herewith the executive report of the Library for the fiscal year ended June 30, 1918.

Respectfully,

CLARIBEL R. BARNETT, *Librarian.*

HON. D. F. HOUSTON,
Secretary of Agriculture.

WORK OF THE YEAR.

The war has affected the work of the Library during the past year in a number of ways. In certain departments the work has increased decidedly, while in others a decrease has been noticeable. Taken as a whole the year was one of progress. In spite of the handicap of insufficient assistance, the Library and its branches have been brought into more vital relation with the Department, with other Departments of the Government, and with institutions and libraries throughout the country. New activities have been begun and new contacts have been made which it is believed will enable the Library to be of still greater usefulness in the future and to approximate more nearly the service which a national agricultural library should render.

REFERENCE AND LOAN DIVISIONS.

MISS EMMA B. HAWKS, *Assistant Librarian*, in general charge.

MISS MARY G. LACY, *Reference Librarian.*

MISS GERTRUDE E. UPTON, *Loan Desk Assistant.*

The most noticeable effect of the war on the work of the Library has been in the reference and loan divisions. While a decrease has occurred in the number of books circulated, the reference work of the main Library and the bureau and division libraries has increased greatly. This increase is due to two causes, first, the war activities of this and other Government departments, which have given rise to many new lines of investigation more or less directly associated with them, and, second, the creation by the Government of various new offices and bureaus for the prosecution of the work of the war. All of these new offices need library facilities in a greater or less degree and none are provided with them to the extent of their needs. This has put upon the established libraries of the Government the

responsibility of supplying their wants in so far as they are able and has of necessity greatly increased the volume of their work. Inquiries have been received in person and by telephone and letter. There has been a marked increase in the number of inquiries received by telephone from offices outside of the Department. When the Library has not been able to supply the required printed data, it has frequently been able to refer the inquirer to the office of the department which could supply the information.

As records are not kept of the reference use of the Library, it is not possible to give a complete list of all the Government offices outside of the Department which have used the Library for reference only, but, by means of the records kept at the loan desk, it is possible to mention a number of those which have borrowed books and periodicals from our collections.

The Food Administration has made frequent use of the facilities of the main Library and also of the branch libraries. Without the resources of our Library to draw upon it would have been considerably hampered in some of its research work, as it has had no appropriation for the purchase of books.

Among the new Government offices which have used the main Library and the branches may be mentioned the American University Experiment Station of the War Department, the Edgewood Arsenal and other branches of the Chemical War Service, the Committee on Public Information, the Federal Board for Vocational Education, the Division of Export Licenses, and other offices of the War Trade Board, various divisions and offices of the Council of National Defense, including the Women's Committee, the Shipping Board, and the War Industries Board.

Among the older offices which have used the Library may be noted the Army Medical School, Combustion and Repair Division of the Navy Department, the Federal Trade Commission, the Military Intelligence Office, the Food Division of the Surgeon General's Office, the Signal Corps, Ordnance Department and Engineers' Office of the War Department, the Department of Labor, the Department of Commerce, the Naval Hospital, Bureau of Mines, Geological Survey, Bureau of Standards, Hygienic Laboratory, Division of Textiles and other offices of the National Museum and Smithsonian Institution, and the Geophysical Laboratory.

In addition to the reference work done in answer to inquiries, a beginning has been made on an information file to supplement the catalogue of the Library. In this will be filed, by subject, printed and typewritten material of interest but of ephemeral value. While too new as yet to have proved its value, it is believed that the file will grow into a most useful reference tool, and that it will simplify the problem of making accessible material of current interest but not suitable for permanent cataloguing.

The reference work of the year and the demands for "up-to-the-minute information" which the war has emphasized have demonstrated forcibly a need for information which can not be met by the catalogue, the information file of ephemeral material, or the various printed indexes. Many of the very special subjects on which inquiries were received were subjects on which little or no printed information was available and which would not, therefore, be included

in the Library catalogue. In a number of instances, however, these subjects were under investigation by offices of the Department which were able to supply the desired information. In order to make these various sources of information readily available, the Library undertook, with the cooperation of the bureau and division libraries and various offices of the Department, the experiment of indexing the subjects under investigation by the various offices of the Department. A beginning on this index has been made. It will contain a list in card form of the offices and specialists in the Department who are willing to supply information on the subjects listed to inquirers when the latter have not succeeded in getting information enough on the subjects from library resources. If the Library is successful in completing the index it is hoped that it may be an aid in handling Department correspondence and that it will also provide an additional means "for getting at the men behind the books, for being led to human sources, to authorities who will consider special needs in personal ways, as books can not do." It is possible that it may also in time be made to help to prevent overlapping and duplication of effort. The purpose in calling attention to the index in its very incomplete form is to bespeak an interest in it in the Department and to suggest to other libraries and institutions dealing with agricultural and scientific subjects the possibility of obtaining additional unprinted information on these subjects from the Department.

CIRCULATION.

The circulation for the year was 76,329 books and pamphlets and approximately 125,000 current periodicals. As the total circulation of books in the fiscal year 1917 was 86,977, the circulation of books during the year shows a decrease of 10,648. This decrease is undoubtedly due to the war conditions. A large number of the scientific workers of the Department have entered the military service. This fact has affected the amount of scientific work done by the Department, and the demands upon the Library for literature have been correspondingly less.

INTERLIBRARY LOANS.

The number of books lent to libraries, institutions, and individuals outside of the city was 893, a decrease of 200 compared with the previous year, due to war conditions, as many of the scientific staffs of the agricultural colleges and experiment stations have also gone into the military service. To the total number of books lent, namely, 893, should be added 84 photostat copies and 11 typewritten copies, making the total use outside of the city 988.

The number of books borrowed from other libraries in the city was 4,717, a decrease of 1,375 compared with the previous year. The number borrowed from libraries outside of the city was only 35, a decrease of 47 compared with the previous year. These 35 books were borrowed from different libraries, the largest number having been borrowed from the Arnold Arboretum. Further detailed statistics with regard to the circulation are given in Appendices 1 to 5. Attention is called to the classification of borrowers, which is given this year for the first time.

ACCESSIONS.

The total number of books, pamphlets, and maps added to the Library during the year was 7,823, a decrease of 1,134 compared with the previous year. This decrease was due principally to the difficulty of obtaining books from foreign countries, including exchanges as well as purchases. Fewer accessions resulted from the binding of serials, as a large number of the foreign periodicals and serials for the last two or three years are incomplete.

According to the record of accessions, the total number of books and pamphlets accessioned by the Library up to July 1, 1918, was 153,226. From this number, however, should be deducted 5,910 volumes which were discarded during the fiscal year 1915 and 570 which were discarded during the last three fiscal years, leaving a balance of 146,746 books and pamphlets in the Library on July 1, 1918. More detailed statistics of the accessions of the year compared with previous years are given in Appendix 6.

A one-week exhibit of recent accessions to the Library known as the "New-book shelves" is maintained in the reading room of the main Library. During the year the exhibit has been enlarged by the purchase of a display case better suited than the shelves to the exhibition of bulletin, pamphlet, and poster material.

Of individual book purchases during the year the most important were Von Siebold's *Flora Japonica* and Millais' *Rhododendrons*. The following sets of periodicals have also been completed: Boston Society of Natural History, *Proceedings*; Buitenzorg, *Java's Lands Plantentuin, Annales*; *Chemisch Weekblad*; *La Clinica Veterinaria*; London, Zoological Society, *Transactions*; *Repertoire de législation et de jurisprudence forestières*.

Among the notable accessions other than books should be mentioned some photostat copies of valuable American manuscripts of agricultural and historical interest which were procured for the Library through the cooperation of Dr. R. H. True, of the Bureau of Plant Industry. First in importance is the *Farm and Garden Book* of Thomas Jefferson, the original of which is contained in the Massachusetts Historical Society library; second, the *Proceedings* of the Albemarle (Va.) Agricultural Society, the original of which is in the Virginia Historical Society library (Thomas Jefferson was a member of this society and prepared the constitution); third, the *Farm Diary* of Edmund Ruffin, which was lent to Dr. R. H. True by a nephew of Edmund Ruffin. This is the second diary of Mr. Ruffin, an earlier one having been destroyed during the Civil War. It contains many data of agricultural and scientific value.

Another important acquisition of the Library outside of the class of books and manuscripts was a bibliography (on cards) of American agricultural periodicals. This bibliography was prepared outside of official hours by Mr. Stephen Conrad Stuntz, who, before his death in February, 1918, was connected with the Office of Seed and Plant Introduction, Bureau of Plant Industry. After his death the bibliography was purchased by the Library. For various reasons it had been impossible for Mr. Stuntz to complete and publish the bibliography as he had originally intended. It is hoped that the Library will later be able to complete the bibliography in accordance with his plans. While much remains to be done to put it in final

shape for printing, it is, even in its incomplete form, a valuable bibliographical tool.

CATALOGUING AND CLASSIFICATION.

MISS HELEN M. THOMPSON, *Chief, Catalogue Division.*

The record of the material classified and catalogued during the year is as follows: 2,186 volumes, 721 pamphlets, 4,853 serials and continuations, and 63 maps and charts, making a total of 7,823, a decrease of 1,134 compared with the preceding year. In addition to the complete cataloguing of the above books, pamphlets, and maps, author cards were made for 570 pamphlets of less importance and 945 "re-prints."

There were added to the main (dictionary) catalogue 26,229 cards, and 3,846 were withdrawn, making a net addition of 22,383, an increase of 3,221 compared with the previous year. The main (dictionary) catalogue now contains approximately 392,000 cards and occupies eleven 60-drawer cabinets.

The number of titles prepared during the year by the Library for printing by the Library of Congress in what is known as the "Agricultural series of catalogue cards" was as follows: Cards for accessions and recatalogued books, 483; cards for Department publications, 577; total, 1,060. The total number of titles prepared by this Library since 1902, in which year the printing of cards was begun, is 30,918.

The amount of uncatalogued material on hand July 1, 1918, was as follows: Forty-one volumes, 178 pamphlets, 190 continuations, and 2 maps. The cataloguing was much retarded during the year by the loss of three experienced cataloguers and the necessity of making temporary appointments to fill the vacancies. Nine temporary assistants were employed in the Catalogue Division during the year, some for periods of only a month. As a consequence, comparatively little progress was made in the work of reclassifying certain portions of the Library, which are badly in need of subdivision.

BIBLIOGRAPHICAL WORK.

In response to a demand from the State agricultural college libraries, a beginning was made by the staff of the main Library and the branch libraries in the preparation of checklists of State agricultural publications. Work has been begun on the publications of the following States: Florida, Idaho, Iowa, Kansas, Minnesota, Nebraska, New Jersey, Ohio, Pennsylvania, Texas, Vermont, and Washington.

The main Library, in cooperation with the branch libraries, also prepared a compilation on the bibliographical work, special indexes, directories, and lists of publications in progress in the Department of Agriculture, which was issued in multigraphed form as Library Notes No. 6.

Various bibliographical lists on food subjects were prepared by the main Library for the periodical "Food News Notes," issued by the Food Administration.

The work of the libraries of the Bureau of Entomology, Bureau of Markets, Bureau of Plant Industry, and Dairy Division in revising the bibliographical lists accompanying the publications of their respective bureaus has been continued.

The Bureau of Chemistry prepared a list of references to periodical articles, and also to patents, which have appeared since July 1, 1914, on products of commercial value, produced by microorganisms.

The Forest Service library prepared in August, 1917, an extensive bibliography on Reforestation covering 90 typewritten pages. Two other special bibliographies prepared in that library were printed during the year, one on Forest Taxation by the extension service of the New Hampshire College of Agriculture and the Mechanic Arts, and a short supplementary "Government Paper Bibliography," by "Paper." The list of books and articles indexed by the Forest Service library is still printed each month in American Forestry.

In the Bureau of Markets library the "Selected List of Publications on the Marketing of Farm Products" compiled in 1915 was revised to April 1, 1918. It covers approximately 80 pages and has been issued in mimeographed form.

In the Bureau of Plant Industry library the current literature on Phytopathology has been indexed and published currently in "Phytopathology."

In the Office of Farm Management library annotated lists have been prepared on the cost of production of various crops.

In the States Relations Service library the manuscript revision of the "List of Publications of the State Experiment Stations" has been brought through 1917. In addition, a subject index on cards to extension publications of the various State agricultural colleges issued since December, 1915, has been prepared and is kept up to date. Typewritten lists of these publications have been prepared for the States in alphabetical order up to and including Nebraska. Beginning with January, 1918, a monthly list of current extension publications has been issued in mimeographed form.

PERIODICALS AND OTHER SERIALS.

MISS LYDIA K. WILKINS, *Chief, Periodical Division.*

The total number of different periodicals, exclusive of annuals and serials of infrequent issue, received currently during the year was 2,433, of which 589 were received by purchase and 1,844 by gift. The number of new periodicals added during the year was 289 whereas 75 of those on last year's list are no longer received, either because they have ceased publication permanently or temporarily or because the subscriptions for them have been discontinued. The net increase for the year was 214. In order to meet the demands for certain periodicals it was necessary to purchase 181 duplicates, making the total number of periodicals purchased 770, a net increase of 19 over the previous year. The Library also received a number of duplicates by gift and exchange, making the total number of periodicals handled currently during the year 3,428, a net increase of 179 for the year.

A decided increase in the use of the periodicals by Government offices outside of the Department, especially new offices, occurred during the year. New lines of work in the Department, due to the war, made necessary the purchase of a number of periodicals on subjects apparently far afield from agriculture—for example, mining and aviation journals. A marked increase is noticed also in the use of commercial papers. Additional information with regard to the current periodicals is contained in Appendices 7 to 9. In Appendix 7 is given the number of different periodicals currently received, arranged by classes. Appendix 8 shows the number emanating from the various foreign countries. Appendix 9 shows the languages other than English in which the periodicals are printed.

In addition to the 2,433 current periodicals, appearing not less than four times a year, the Library received 3,904 serials of less frequent issue, such as annual reports, proceedings, and transactions published by institutions and societies, a decrease of 701 compared with the previous year. This decrease was due to the difficulty of obtaining publications from foreign countries.

DUPLICATES.

While the Library received as large a number of duplicates during the year as in previous years, it was not possible, on account of lack of assistance, to devote as much time to the work of disposing of them. Only one list of duplicates was prepared during the year. The items selected from this and earlier lists filled 20 mail sacks. The majority of the duplicates are selected by the libraries of the State agricultural colleges and experiment stations.

BINDING.

MISS FANNY L. PARKER, *in Charge*.

The number of books and periodicals sent to the Government Printing Office for binding during the year was only 1,674, a decrease of 2,390 compared with the previous year. In addition to the books and periodicals permanently bound, 1,674 were laced in temporary binders (being 326 less than in 1917), and 1,443 pamphlets were stapled in pamphlet binders (being 285 less than in 1917). The amount of binding done in the last year is the smallest in years. In July, 1917, the junior assistant who did the work in connection with the temporary binding entered the military service. In January, 1918, the clerk who had helped for 10 years with the preparation of the books for permanent binding resigned, and it has thus far been impossible to fill his place. At the same time, it was necessary to ask the assistant in charge of the binding to undertake other duties in addition to the bindery work, on account of the loss of assistants in other divisions of the Library. As a result of these and other handicaps due to war conditions, the bindery work has suffered greatly in the past year.

AFFILIATED ACTIVITIES.

The various activities of the main Library and the bureau and division libraries described under the above heading in last year's report

of the Library have been continued and in some instances expanded, but no new activities have been undertaken.

PUBLICATIONS.

In December, 1917, the Library issued its report for the fiscal year 1917, a pamphlet of 13 pages. In June, 1918, it issued Library Leaflet No. 1, entitled "Raise Chickens." This leaflet of four pages, with illustrated cover, contained a list in readable form of publications of the Department on poultry. Similar leaflets entitled "Raise Pigs" and "Raise Sheep," issued as Leaflets Nos. 2 and 3 and containing lists of publications of the Department on pigs and sheep, were sent to the printer before July 1, and have since appeared. The illustrations for the covers of these leaflets were contributed by the artist, Mr. C. B. Fall. The leaflets were issued to further an intelligent interest in the present problems of increased food production and conservation.

Four numbers of the multigraphed publication of the Library entitled "Library Notes" were issued during the year. The titles were as follows: No. 3, Directories; No. 4, New serial publications of the Government; No. 5, New book shelves and display case for new bulletin and pamphlet material; No. 6, Bibliographical work, special indexes, directories, and lists of publications in progress in the Department of Agriculture.

LIBRARY STAFF.

The number of employees carried on the roll of the main Library at the close of the year was 35, the same as last year; the number employed by the bureau, division, and office libraries was 44. The total number, 79, employed in the main Library and the bureau, division, and office libraries includes 61 librarians, library assistants, and stenographers, 1 translator, 15 messengers, and 2 charwomen.

While fortunately few changes have taken place in the more responsible positions in the main Library and the bureau, division, and office libraries, the changes in the personnel as a whole have been unusually numerous. In the main Library 26 resigned, including two who entered the military service. In some instances a position was vacated two or three times during the year, as it was possible to make only temporary appointments. Out of the main Library's staff of 35 on July 1, 1918, 12, or 33 per cent were newly appointed during the year. Of the 26 who resigned, 13 were library assistants, 2 clerical assistants, and 11 messengers. The present unsettled conditions due to the war and the large number of low-salaried positions on the statutory roll of the Library have been the cause of the resignations. The difficulty of filling these lower positions has been greater than ever before.

In view of the fact that no Civil Service eligibles were available for appointment to fill the library assistant positions, it was necessary to make temporary appointments, pending the establishment of an eligible register by the Civil Service Commission. On account of the difficulty of finding permanent assistants at the salaries the Library was able to offer, it was decided to take advantage of this opportunity

to offer temporary appointments to assistants in agricultural college libraries who wished to have experience in this Library. Librarians or library assistants from four agricultural libraries availed themselves of this opportunity, namely, the Nebraska College of Agriculture, the Agricultural College Library of the Iowa State College, the Virginia Polytechnic Institute, and the Kansas State Agricultural College. The experience gained in this Library will, it is believed, be helpful to the agricultural libraries represented, and it will also be an advantage to this Library to have been brought in closer touch with agricultural college libraries.

Library staff meetings were held each month from October, 1917, to June, 1918.

WAR SERVICE.

In addition to its normal and regular duties to the Department, the Library has endeavored to render assistance in other war activities of the Government by lending two of the library assistants, one for two weeks and the other for a month, to the Committee on Public Information for the work of preparing an information file of Government activities and officials, and by helping in the food conservation campaign. The Librarian was appointed in June, 1917, as chairman of the American Library Association food information committee, and in that capacity as well as through the Library has endeavored to aid in various ways in the work for food conservation and increased production. In August, 1917, a circular letter was sent to the public libraries of the country calling attention to the opportunities for libraries to serve in this work. Lists on food subjects have also been prepared and publications of the Department on these subjects have been sent in quantities to libraries for distribution.

BUREAU, DIVISION, AND OFFICE LIBRARIES.

The usual work of the branch libraries in the bureaus, divisions, and offices has continued along the lines reported in previous years, and there have been no new undertakings of importance or changes in organization. On account of the expansion of the Bureau of Markets, due to new war activities, the work of the library of the bureau has been affected to a greater extent than the work of other bureau libraries.

The table following gives certain statistics with regard to the various libraries and the names of the librarians in charge. Additional statistics with regard to the use of the books in these various libraries are given in Appendix 1. An account of their bibliographical work and other activities is given on preceding pages of this report.

Books, pamphlets, and periodicals in bureau, division, and office libraries.

Bureau or office.	Librarian in charge.	Number employed.	Number of books.	Number of pamphlets.	Number of periodicals currently received.	Number of registered borrowers.	Number of registered borrowers to whom periodicals are circulated.
Bureau of Animal Industry: ¹							
Animal Husbandry Division.	Miss Jessie Urner.....	1	1, 170	² 4, 000	185	35	35
Dairy Division.....	Miss Carrie B. Sherfy..	3	790	² 2, 000	227	56	51
Biochemic, Pathological, Zoological, and other divisions.	Miss Elsie Moore ³	1	166	232	263	75	65
Bureau of Biological Survey	Mr. W. H. Cheesman ⁴ .	2	⁵ 6, 650	.....	96	36	42
Bureau of Chemistry.....	Miss Anne E. Draper..	4	⁵ 6, 850	.....	342	223	90
Bureau of Crop Estimates..	Mrs. Ellen H. Painter..	3	⁵ 16, 000	.....	486	30	.....
Bureau of Entomology.....	Miss Mabel Colcord....	2	² 7, 000	² 8, 850	.....	179	8
Bureau of Markets.....	Miss Caroline B. Sherman.	6	3, 400	1, 300	450	175	36
Bureau of Plant Industry...	Miss Eunice R. Oberly	9	² 4, 000	² 1, 000	563	293	179
Forest Service.....	Miss Helen E. Stockbridge.	2	⁵ 20, 149	.....	74	122	44
Office of Farm Management.	Miss Cora L. Feldkamp.	4	⁵ 9, 371	.....	278	75	51
Office of Public Roads and Rural Engineering.	Miss Grace Francis....	1	⁵ 5, 000	.....	132	97	35
Office of the Solicitor.....	Mr. F. B. Scott.....	1	² 1, 700	.....	.....	.....	.....
States Relations Service....	Miss E. Lucy Ogden..	7	² 2, 700	² 3, 000	.....	.....	.....

¹ No bureau library is maintained.² Approximate figures.³ Periodical assistant.⁴ Editor and librarian.⁵ Books and pamphlets.

All books for the use of the Department in Washington, including those filed in the bureaus, are purchased and catalogued by the main Library. No bureau libraries are maintained by the Bureau of Animal Industry and the Bureau of Soils. The Weather Bureau library is administered separately, with the exception that the books and periodicals are purchased from the appropriation for the Library of the Department, the sum of \$1,000 being set aside each year for this purpose. The report of the Weather Bureau library is contained in the report of the Weather Bureau.

As noted in previous reports, books for "field use"—that is, for use outside of Washington—can be purchased from the funds of the bureaus, divisions, and offices. The records in connection with the books and periodicals purchased for use in the field are, in the majority of the bureaus, cared for by the libraries of the bureaus. The amounts spent for such books during the year, as reported by the various bureau libraries, were approximately the same as last year.

While there were no changes in the location of the various branch libraries, with the exception of the Biological Survey library, which was moved to other rooms on the same floor, there were numerous changes in the location of offices of the Department due to expansion in their work. A number of offices have been moved to a considerable distance from the Department grounds, which has complicated the delivery of books and current periodicals to these offices. Under present conditions, it is difficult for the main Library as well as the bureau, division, and office libraries to give prompt service.

APPENDICES.

APPENDIX 1.

STATISTICS OF CIRCULATION.

Books and periodicals charged by the main Library and the bureau, division, and office libraries during the fiscal years 1917 and 1918.

Bureau, division, or office.	Number of books charged.								Number of periodicals charged.	
	To individuals.		To main Library.		To branch libraries.		Total.			
	1917	1918	1917	1918	1917	1918	1917	1918	1917	1918
Main Library ¹	16,192	13,332	-----	-----	30,147	27,115	46,339	40,447	-----	-----
Bureau of Animal Industry: ²										
Animal Husbandry Division.....	(3)	(3)	(4)	(4)	(4)	(4)	-----	-----	3,660	4,000
Dairy Division.....	1,975	2,386	48	48	17	6	2,040	2,440	10,176	9,518
Biochemic, Pathological, Zoological, and other divisions.....	(3)	(3)	(4)	(4)	(4)	(4)	(3)	(3)	11,096	10,401
Bureau of Chemistry....	9,627	8,238	689	650	14	24	10,330	8,912	15,246	15,801
Bureau of Entomology..	3,105	2,920	522	325	131	39	4,550	3,284	905	1,159
Forest Service.....	3,495	2,844	422	393	2	2	4,094	3,239	4,809	4,987
Bureau of Markets.....	(4)	(4)	(4)	(4)	(4)	(4)	(4)	(4)	20,987	6 25,000
Bureau of Plant Industry.....	⁵ 11,684	12,442	⁵ 666	598	⁵ 34	85	⁵ 12,521	13,125	38,398	37,317
Office of Farm Management.....	3,922	3,118	-----	58	-----	8	3,922	3,184	7,793	10,633
Office of Public Roads and Rural Engineering	2,997	1,516	182	170	12	12	3,181	1,698	4,566	6,924
	52,997	46,796	2,529	2,242	30,357	27,292	86,977	76,329	116,936	125,740

¹ Statistics include circulation in all bureaus and offices not mentioned below.

² No bureau library is maintained. The statistics of circulation of books are included in those of the main Library.

³ Circulation statistics included in statistics of main Library.

⁴ No records kept.

⁵ Statistics for only 10 months.

⁶ Approximately.

APPENDIX 2.

The following table indicates the growth in the work of the circulation division of the main Library during the past five years:

Statistics of circulation (main Library), fiscal years 1914 to 1918.

Item.	1914	1915	1916	1917	1918
Largest number of books charged on any day.....	214	268	248	317	249
Smallest number of books charged on any day.....	39	37	57	32	39
Average number of books charged daily.....	126	134	160	151	132
Largest number of books charged in any month.....	4,454	4,260	5,028	4,839	4,099
Smallest number of books charged in any month.....	2,083	2,567	3,077	2,882	2,770
Average number of books charged monthly.....	3,239	3,412	4,076	3,861	3,370
Total number of books charged during the year.....	38,879	40,953	48,914	46,339	40,447

APPENDIX 3.

CLASSES OF BORROWERS.

	No. of persons.
(a) Department employees.....	1,915
(b) Libraries and Government offices in Washington.....	24
(c) Individuals in Washington outside of the Department.....	92
(d) Libraries and institutions outside of Washington.....	85
(e) Business firms outside of Washington.....	4
	<hr/> 2,120

APPENDIX 4.

INTERLIBRARY LOANS.

Record of books lent outside of Washington during the fiscal years 1914 to 1918.

States, etc.	Fiscal year—					States, etc.	Fiscal year—				
	1914	1915	1916	1917	1918		1914	1915	1916	1917	1918
Alabama.....	3	3	.....	10	.....	New Mexico.....	4	3	9	8	6
Arizona.....	6	4	14	.....	7	New York.....	113	142	127	148	103
Arkansas.....	.....	2	3	4	5	North Carolina.....	30	48	17	15	7
California.....	27	26	50	38	13	North Dakota.....	11	3	11	3	6
Colorado.....	12	27	24	16	7	Ohio.....	103	78	29	41	56
Connecticut.....	4	4	2	2	5	Oklahoma.....	1	.....	.....	.....	.....
Delaware.....	18	11	10	6	17	Oregon.....	44	51	66	51	73
Florida.....	20	44	21	15	21	Pennsylvania.....	19	21	29	19	21
Georgia.....	14	15	37	24	5	Rhode Island.....	1	6	2	17	4
Idaho.....	5	9	5	10	6	South Carolina.....	1	1	22	27	14
Illinois.....	12	7	66	30	44	South Dakota.....	.....	3	.....	.....	.....
Indiana.....	7	25	20	13	11	Tennessee.....	26	20	31	22	19
Iowa.....	24	63	80	40	52	Texas.....	9	23	11	38	8
Kansas.....	12	59	71	38	31	Utah.....	.....	8	17	16	8
Kentucky.....	4	25	7	4	8	Vermont.....	30	21	9	3	3
Louisiana.....	2	2	10	8	21	Virginia.....	54	32	26	18	4
Maine.....	11	8	22	16	10	Washington.....	14	8	11	2	8
Maryland.....	7	25	28	48	30	West Virginia.....	2	12	16	8	19
Massachusetts.....	18	36	25	33	22	Wisconsin.....	31	38	41	34	36
Michigan.....	35	22	37	38	21	Wyoming.....	.....	4	5	3	.....
Minnesota.....	7	64	78	50	44	Canada.....	.....	1	.....	1	1
Mississippi.....	3	4	.....	1	1	Hawaii.....	2	.....	.....	3	2
Missouri.....	19	18	15	19	6	Porto Rico.....	67	57	43	39	28
Montana.....	13	5	15	19	37	Canal Zone.....	1	.....	.....	.....	.....
Nebraska.....	20	20	18	10	4	Alaska.....	.....	.....	2	.....	.....
Nevada.....	.....	.....	3	1	1						
New Hampshire.....	5	3	2	8	10	Total.....	896	1,196	1,240	1,093	893
New Jersey.....	24	83	53	76	28						

APPENDIX 5.

Summarized statement of books borrowed from other libraries during the fiscal years 1914 to 1918.

Item.	1913	1914	1915	1916	1917	1918
Largest number of books borrowed from other libraries on any day.....	43	40	42	42	41	46
Average number of books borrowed from other libraries daily.....	18	16	18	23	19	15
Largest number of books borrowed from other libraries in any month.....	731	564	579	734	623	481
Average number of books borrowed from other libraries monthly.....	480	432	460	571	507	396
Number of books borrowed during the year from libraries outside of Washington.....	91	62	58	86	82	35
Number of books borrowed during the year from other libraries in Washington.....	5,677	5,166	5,463	6,774	6,010	4,717
Total number of books borrowed from other libraries in and out of Washington.....	5,768	5,228	5,521	6,860	6,092	4,752

Of the 4,717 books borrowed from libraries in the city during the year, 3,567 were borrowed from the Library of Congress, 878 from the Surgeon General's library, 124 from the National Museum and Smithsonian Institution, 49 from the Geological Survey, 25 from the Patent Office, 24 from the Bureau of Education, and the remaining 50 from 10 other Government libraries.

APPENDIX 6.

Accessions to the Library for the fiscal years 1914 to 1918.

Accessions.	1914	1915	1916	1917	1918
Purchases:					
Volumes.....	1,548	1,353	1,595	1,949	1,510
Pamphlets.....	41	39	49	76	79
Maps and charts.....	1	.....	13	1	4
Serials and continuations.....	511	376	274	147	97
Total.....	2,101	1,768	1,931	2,168	1,690
Gifts:					
Volumes.....	719	780	873	641	676
Pamphlets.....	470	500	397	508	642
Maps and charts.....	20	22	18	4	59
Continuations.....	4,490	4,909	4,919	4,458	3,807
Total.....	5,699	6,211	6,207	5,611	5,184
From binding periodicals and serials	1,826	1,085	1,612	1,178	949
Total.....	9,626	9,064	9,750	8,957	7,823

APPENDIX 7.

The number of current periodicals received, arranged by classes, is shown in the following table:

Statistics of current periodicals.

Class.	Purchase.	Gift.	Total.	Class.	Purchase.	Gift.	Total.
Agriculture, United States...	11	199	210	Manufactures.....	15	34	49
Agriculture, foreign.....	18	185	205	Flour and feeding stuffs, etc..	6	13	19
Veterinary medicine.....	19	34	53	Ice and refrigeration.....	3	7	10
Dairying.....	13	31	44	Paper.....	7	2	9
Poultry and pigeons.....	3	47	50	Printing.....	.....	4	4
Live stock and meat trade...	8	57	55	Photography.....	7	1	8
Soils and fertilizers.....	1	8	9	Physics.....	4	.....	4
Drainage and irrigation.....	2	.....	2	Meteorology.....	.....	3	3
Farm implements and machinery.....	5	14	19	Chemistry and chemical technology.....	36	38	74
Moor culture and peat.....	1	7	8	Food.....	5	27	32
Agricultural products.....	20	57	77	Home economics.....	2	6	8
Fibers and textiles.....	5	9	14	Pharmacy.....	9	14	23
Horticulture and landscape gardening.....	29	67	96	Geology and mineralogy.....	2	7	9
Forestry.....	11	47	58	Natural history.....	8	38	46
Experiment station publications (United States).....	.....	110	110	Zoology.....	10	17	27
Experiment station publications (foreign).....	.....	26	26	Hunting and fishing.....	6	6	12
General.....	21	14	35	Ornithology.....	10	6	16
Bibliography and library economy.....	20	12	32	Entomology.....	27	27	54
Education, including agricultural extension.....	3	145	148	Beekeeping.....	6	7	13
Economics and sociology.....	17	43	60	Microscopy.....	3	.....	3
Commerce and statistics.....	63	174	237	Biology.....	11	8	19
Groceries.....	8	10	18	Medicine, physiology and hygiene.....	39	61	100
Engineering.....	17	22	39	Bacteriology.....	5	1	6
Building.....	4	4	8	Botany.....	28	22	50
Roads.....	2	17	19	General science.....	14	56	70
Railroads.....	11	17	28	Geography.....	2	6	8
Aviation.....	3	.....	3	Law.....	8	1	9
				United States Government documents.....	1	76	77
				Total.....	589	1,844	2,433

APPENDIX 8.

Foreign countries from which periodicals are currently received.

Country.	Titles.	Country.	Titles.
Africa.....	41	Norway.....	7
Australia.....	32	Persia.....	1
Austria ¹	25	Panama.....	2
Barbados.....	2	Philippine Islands.....	15
Belgium ¹	4	Portugal.....	4
Bulgaria ¹	2	Porto Rico.....	2
Canada.....	76	Roumania ¹	5
Ceylon.....	2	Russia ¹	27
China.....	1	Scotland.....	13
Cuba.....	11	South America:	
Denmark.....	15	Argentina.....	20
England.....	193	Bolivia.....	1
Finland ¹	1	British Guiana.....	2
France.....	122	Brazil.....	20
French Indo-China.....	1	Chile.....	5
Germany ¹	258	Colombia.....	5
Greece.....	1	Dutch Guiana.....	2
Hawaii.....	3	Paraguay.....	1
Honduras.....	2	Peru.....	8
Hungary ¹	12	Uruguay.....	5
Iceland.....	2	Venezuela.....	1
India.....	38	Spain.....	21
Ireland.....	10	Straits Settlements.....	2
Italy.....	76	Sumatra.....	2
Jamaica.....	2	Sweden.....	21
Japan.....	21	Switzerland.....	22
Java.....	16	Trinidad.....	3
Mexico.....	17	Yucatan.....	1
Netherlands.....	23		
New Caledonia.....	1		
New Zealand.....	8	Total.....	1,236

¹ Not received during the past year on account of the war.

APPENDIX 9.

Languages other than English in which the periodicals are printed.

Language.	Titles.	Not received during the year on account of the war.
Bohemian.....	3	1 from Bohemia, Austria.
Bulgarian.....	2	
Chinese.....	1	
Danish.....	15	
Dutch.....	43	
Finnish.....	1	
French.....	153	4 from Belgium, 1 from Russia, 1 from Roumania.
German.....	304	24 from Austria, 258 from Germany, 4 from Hungary, 1 from Russia.
Greek.....	1	
Hungarian.....	10	8 from Hungary.
Icelandic.....	2	
Italian.....	69	
Japanese.....	15	
Norwegian.....	8	
Portuguese.....	21	
Roumanian.....	4	
Russian.....	22	
Spanish.....	100	
Swedish.....	27	1 from Finland, 3 from Russia.
Tamil.....	1	
Total.....	802	

APPENDIX 10.

FINANCIAL STATEMENT.

A comparison of the receipts and expenditures of the Library for the last five years is given in the following table:

Financial statement, fiscal years 1914 to 1918.

RECEIPTS.

Source of receipt and object of expenditure.	Fiscal year—				
	1914	1915	1916	1917	1918
Source:					
Library appropriation.....	\$43,520.00	\$45,360.00	\$46,020.00	\$49,520.00	\$50,160.00
From department printing and binding fund.....	11,345.84	10,190.62	9,662.12	8,707.52	12,375.11
Total.....	54,865.84	55,550.62	55,682.12	58,227.52	62,535.11

EXPENDITURES.

Object:					
Books and serials.....	¹ \$9,100.00	¹ \$8,512.15	¹ \$9,117.24	¹ \$10,233.21	¹ \$8,305.08
Periodicals.....	¹ 4,232.41	¹ 3,511.18	¹ 4,154.11	¹ 4,249.99	¹ 3,950.28
Maps.....				215.00	40.88
Index cards.....	168.03	181.56	161.15	¹ 129.61	¹ 100.00
Supplies and repairs.....	556.93	384.55	384.80	435.97	¹ 784.38
Furniture, shelving, and miscellaneous equipment.....	904.73	3,112.18	699.67	584.50	¹ 885.64
Traveling expenses.....			31.20		
Freight, express, and drayage.....				10.04	¹ 15.00
Salaries (main library).....	28,377.17	29,585.50	31,278.06	33,025.53	33,272.25
	43,339.28	45,287.12	45,826.23	48,883.85	47,353.51
Printing.....	1,892.25	1,895.47	1,806.79	1,727.17	1,576.78
Binding.....	9,453.59	8,295.15	7,855.33	6,980.35	10,491.60
	11,345.84	10,190.62	9,662.12	8,707.52	12,068.38
Total.....	54,685.12	55,477.74	55,488.35	57,591.37	59,421.89

¹ Approximate figures.

From the total, \$10,491.60, spent for binding in the past year, \$7,684.69 was spent for regular binding and \$2,806.91 for binders. From the \$1,576.78 spent for printing, \$50.08 was spent for the printing of the annual report of the Librarian for 1917, \$251.70 for forms, and \$1.275 for the cards printed, through the Library of Congress, for the publications of the department and for the accessions.

APPENDIX 11.

A. L. A. FORM FOR LIBRARY STATISTICS.¹

Annual report for year ended June 30, 1918.

Name of library, U. S. Department of Agriculture Library.

City or town, Washington, D. C.

Terms of use, free for lending to department employees, free for general reference.

Total number of agencies, 14 (consisting of main Library and 13 branches).

¹ Libraries which print their annual reports are requested by the American Library Association to include therein their statistics presented according to a form compiled by the American Library Association Committee on Library Administration, as this facilitates comparison. The statistics of the Library are given above in the American Library Association form in so far as the records kept by the Library make it possible.

Number of days open during year, 306.

Hours open each week for lending, 45 for nine months, 41½ during three summer months.

Hours open each week for reading, 45 for nine months, 41½ during three summer months.

Total number of staff, 35 in main Library, 44 in branches.

Number of volumes added during year by purchase, 1,510.

Number of volumes added during year by gift and exchange, 676.

Number of volumes added during year by binding material not otherwise counted, 949.

Number of volumes withdrawn during year, 249.

Number of pamphlets added during year, 1,291.

Number of serials added during year, 3,904.

Number of maps and charts added during year, 63.

Total number of books and pamphlets, 146,746.

Total recorded use, 171,796.

Number of interlibrary loans, 988.

Total number of registered borrowers, 2,210.

Number of periodicals currently received, 2,433 titles, 3,428 copies.

FINANCE.

RECEIPTS.		PAYMENTS FOR—	
Government appropriation_	\$50,160.00	Books _____	¹ \$7,882.67
From department printing		Periodicals_____	¹ 3,950.28
and binding fund_____	12,375.11	Other serials_____	¹ 422.41
		Salaries, library service__	33,272.25
		Printing and binding_____	12,068.38
		Other maintenance_____	1,799.98
Total_____	62,535.11	Total_____	59,395.97

¹ Approximate figures.

REPORT OF THE DIRECTOR OF THE STATES RELATIONS SERVICE.

UNITED STATES DEPARTMENT OF AGRICULTURE,
STATES RELATIONS SERVICE,
Washington, D. C., September 30, 1918.

SIR: I have the honor to present herewith the report of the States Relations Service for the fiscal year ended June 30, 1918.

Respectfully,

A. C. TRUE, *Director.*

Hon. D. F. HOUSTON,
Secretary of Agriculture.

INTRODUCTION.

The States Relations Service represents the Secretary of Agriculture in his relations with the State agricultural colleges and experiment stations under the acts of Congress granting funds to these institutions for agricultural experiment stations and cooperative extension work in agriculture and home economics, and in carrying out the provisions of acts of Congress making appropriations to the Department of Agriculture for farmers' cooperative demonstration work, investigations relating to agricultural schools, farmers' institutes, and home economics, and the maintenance of agricultural experiment stations in Alaska, Hawaii, Porto Rico, and Guam.

The organization of the service includes the following offices: (1) The Office of the Director, which deals with the general business and administration of the service and the work relating to agricultural instruction and farmers' institutes; (2) the Office of Experiment Stations; (3) the Office of Extension Work in the South, including the farmers' cooperative demonstration work and the cooperative extension work in 15 Southern States; (4) the Office of Extension Work in the North and West, including the farmers' cooperative demonstration work and the cooperative extension work in 33 Northern and Western States; and (5) the Office of Home Economics, including investigations relative to foods, clothing, and household equipment and management.

During the past year the service also had charge of the work authorized by Congress in the item in the food-production act of August 10, 1917, providing \$4,348,400 "for increasing food production and eliminating waste and promoting conservation of food by educational and demonstrational methods through county, district, and urban agents and others." This war-emergency fund was used through the two extension offices for the expansion of those features

of the cooperative extension system involved in the work of the county agricultural agents, home-demonstration agents, and boys' and girls' clubs.

The service directly administered regular and emergency appropriations aggregating \$6,016,060, and had administrative and advisory relations regarding the expenditure of \$3,520,000 of Federal funds (\$1,440,000 for agricultural experiment stations and \$2,080,000 for cooperative extension work) and \$1,600,000 of State funds used as an offset for Federal funds under the cooperative extension act. In addition, the agricultural colleges and experiment stations used in experimental and extension enterprises over \$7,000,000 derived from sources within the States.

On June 30, 1918, the force carried on the rolls of the States Relations Service aggregated about 6,800 employees. The State agricultural experiment stations employed about 2,000 persons, of whom about 700 did some extension work. The total number of persons employed in cooperative extension work in agriculture and home economics was about 7,500.

When the European war began the United States had just entered on the development of a national system of extension work in agriculture and home economics which involved not only the practical training of farmers and their families, but also their organization for individual and community action in the improvement of agricultural practice and the economic and social condition of rural homes and communities. This system combines the scientific and educational forces of the United States Department of Agriculture and the State agricultural colleges with the practical knowledge and experience of multitudes of farm men and women organized to conduct demonstrations on their own farms and to take the leadership in helpful movements in their own communities. Well-trained Federal, State, and county experts work hand in hand with voluntary workers representing the most intelligent and progressive elements of the rural population.

The entry of the United States into the war found this extension system partly organized in all the States and in about half the counties. Immediately it was seen that both for the benefit of the farming people and for the promotion of the general welfare it was highly desirable that every agricultural county should have this organization as soon as possible. In this way both Government and people would have the best means for bringing about the agricultural production and food conservation required by war conditions. The Government would also be kept informed regarding the attitude and needs of the farming people and could enlist their sympathy and support in those patriotic endeavors, such as the liberty loan, Red Cross, and other campaigns, by which information regarding our war aims and requirements is disseminated and means for the successful prosecution of the war are secured.

The Secretary of Agriculture recommended and Congress provided means for the rapid expansion of the extension system. The States Relations Service has been principally engaged in this work during the past year. And as the organization of the extension service has grown, practically all branches of the service have contributed in

some way to meeting its needs. The chief burden has necessarily fallen on the two extension offices. The Office of Experiment Stations has promoted extension work in Alaska, Hawaii, Porto Rico, and Guam, which had regular appropriations available for this purpose. The office has also encouraged the stations in the States to adapt their work to the emergency conditions, which they have done in large measure, not only supplying the needed information but taking an active part in the various efforts for stimulating production, avoidance of unnecessary loss, and making the farmers' efforts more effective.

The Office of Home Economics made special studies of war foods and diets and prepared numerous publications which were widely used in connection with the extension work, as well as through general distribution by the department and the Food Administration.

The Office of the Director dealt with a large number of administrative problems growing out of relationships, projects, and expenditures under the regular and emergency extension acts and a vast amount of details connected with the appointment of thousands of new employees, authorizations for their work, and settlement of their accounts.

The broad range of the extension work, especially under war conditions, has brought the service into more or less definite relationships, not only with the department bureaus, the State agricultural colleges, and the county organizations with which they ordinarily deal, but also with the Federal Board for Vocational Education, the Bureau of Education, State boards and departments of agriculture and education, the Food Administration, the Council of National Defense, and other National and State organizations dealing with war problems. The extension forces and the organizations supporting their work deal in some way with practically all the problems of agriculture and country life. Increasing attention has therefore to be given to the formation of helpful and harmonious relationships with other organizations operating to any extent in the same field.

Considering all the circumstances a remarkable task has been accomplished. On July 1, 1918, at least 2,435 counties had the services of an agricultural agent and 1,715 counties had a home-demonstration agent. There were also home-demonstration agents in about 200 of the larger cities. About 2,000,000 boys and girls were connected with the agricultural and home economics clubs.

Much remains to be done to perfect this organization and make it in all the counties a permanent factor in the development of the community. A broad foundation has been laid. The American farmer and his family are now in close personal touch with a large corps of well-trained men and women so linked with Federal and State institutions for the promotion of agriculture that the farming people can readily avail themselves of the results of scientific research and practical experience the world over to aid them in their work on the farm and their life in the home. Fully two-thirds of this extension organization has been developed during the past year.

Through the home-demonstration agents, boys' and girls' clubs, and gardening specialists very many city people now have expert advice and assistance in food production and conservation. They are also getting a better understanding of the problems involved in

the production and marketing of farm products and are being brought into more helpful and sympathetic relationships with their neighbors on the farms.

OFFICE OF THE DIRECTOR.

The general administrative business of the States Relations Service very greatly increased during the past year. Many new problems connected with expanding and more complicated relationships with the department bureaus, other Federal agencies, the agricultural colleges, and other State institutions and organizations brought the necessity for large numbers of conferences and much correspondence, together with the consideration of very many project agreements.

The routine business connected with appointments, accounting, records, property, distribution of publications, and other material to the field forces, etc., was very large. This involved the employment of many persons unfamiliar with the requirements of Government business and threw a very heavy burden on the chief administrative officers and their trained assistants. A large amount of overtime work was required and cheerfully performed in this and other branches of the service. The loyalty and self-sacrificing spirit of the service's force in all its grades deserves great commendation.

EDITORIAL DIVISION.

W. H. BEAL, *Chief.*

The work of this division included (1) the handling in an editorial capacity of all of the publications of the service except Experiment Station Record; (2) the business connected with the collection, preparation, and distribution of illustrative material for the use of employees and collaborators of the service.

The general character of the editorial work was not modified materially during the year. There was a slight decrease in the total number and volume of publications issued, but a relative increase in those of a more popular character needed especially in the extension work of the service bearing on food production and conservation.

The service issued during the year 95 documents aggregating 4,218 pages, as follows: Seventeen numbers of Experiment Station Record, 2 reports, 10 technical bulletins, 1 article in the Journal of Agricultural Research, 10 publications of the insular stations, 8 Farmers' Bulletins, 5 illustrated lectures (with lantern slides), 40 documents relating to cooperative extension work in agriculture and home economics, and 2 administrative circulars. The service also contributed four numbers to the series of circulars of the Secretary's Office. In addition to these formal documents the service issued, either in printed or in mimeographed form, a number of informal documents, including leaflets of various kinds, blank forms, record books, and the like, required in connection with special features of the work of the service, and cooperated with the Office of Information in the preparation of a considerable amount of press and other informational material of wider general interest especially connected with the emergency work of the department relating to food production and conservation.

There was a marked increase in the work connected with the collection and preparation of illustrative material for the use of employees and collaborators of the service. The carefully selected collection of photographs secured from the various bureaus of the department and from field workers of the service was supplemented by a considerable number of photographs taken either by our own force or in cooperation with the Division of Publications. The collection now contains about 9,000 photographs, of which about 7,500 are mounted, classified, and catalogued for ready use. Over 2,000 new photographs were added during the year. The total number of lantern slides made was 9,740, of which 2,466 were colored.

In addition to cooperating with other offices of the service in securing suitable illustrative material for their work, the division organized several series of lantern slides for special purposes. With a view to aiding the emergency extension work, the preparation of several series of slides was undertaken, as, for example, on wheat, corn, pork, and alfalfa production. These slides are especially intended for the use of extension specialists, county agents, or other workers cooperating or collaborating with the service who are already familiar with the subject matter and desire a number of good illustrations to reinforce their talks or lectures. It is the purpose to develop in this way a flexible collection of slides that will meet a large variety of local needs and conditions.

The division is making a special feature of lantern-slide color work, the colorists employed being given opportunity whenever possible to study at first hand the natural coloring of the subject matter with which they deal. As a result their work is of unusually high quality. In addition to the coloring of lantern slides, some attention is being given to the coloring of bromide enlargements.

About 800 shipments, aggregating 32,000 slides, were made to users of the slides within the service or to schools collaborating with the service, and to a very limited extent to others. A limited number of charts were made for the use of the various offices of the service.

The force of the division was increased during the year by the appointment of a specialist in visual instruction, to have charge of the work relating to illustrative material, and an additional lantern-slide colorist.

INVESTIGATIONS ON AGRICULTURAL INSTRUCTION IN SCHOOLS.

ALVIN DILLE, *Acting in charge.*

These investigations dealt as heretofore with methods and subject matter of instruction in agriculture, especially in secondary and elementary rural schools.

Increased demands developed during the year out of the war situation, and as a result of quickened interest in agricultural education. The situation created by the war was reflected in the topics selected for publication. The bulletins, documents, and leaflets which dealt with pork production, increase of food production, food utilization, etc., were given the right of way and as much as possible was done to show teachers how to make their school work in agriculture and home economics serve the present needs of the country.

Two bulletins for teachers of agriculture in secondary schools, one on Courses in Secondary Agriculture for Southern Schools (Third

and Fourth Years) and the other on Judging Sheep as a Subject of Instruction in Secondary Schools, were published. Eleven circulars were also published in which up-to-date subject matter in a number of branches of agriculture, prepared in cooperation with the bureaus of the department, was presented in suitable form for use in secondary schools. A bulletin on the home project as a phase of vocational agricultural education was prepared at the request of the Federal Board for Vocational Education, and submitted to the board for publication. A bulletin on Lessons on Pork Production for Rural Elementary Schools and a revision of one on Lessons on Corn for Rural Elementary Schools were issued. A similar bulletin on Lessons on Dairying for Rural Schools was prepared. The series of leaflets on the use of individual Farmers' Bulletins in elementary schools was continued and 10 were prepared, of which number 8 were printed. The classified lists of publications, lists of references, sources of material, etc., for school use increased in number. Because of the necessity of frequent revisions these lists are now multi-graphed.

While the anticipated work under the Smith-Hughes vocational-education act has stimulated certain secondary schools, it is quite evident that there is an awakened interest in agricultural instruction on the part of the elementary schools, normal schools, and other institutions. The number of schools reported as engaged in teaching agriculture has not increased at a phenomenal rate, but in many cases the quality of the work has greatly improved. This was shown in an increased demand for assistance on the part of many schools and colleges and has included the call for illustrative material, publications, and information as to ways and means of teaching agriculture.

The demand for lantern slides has been far in excess of that of any other year, and the available sets have proven entirely inadequate. The office has prepared lantern slide sets with lecture syllabi on How to Teach Poultry Lessons, Sheep Judging and Breeds of Sheep, Tomato Growing, and one set on phases of instruction in garden practice. Sets which were previously in use are being revised and lecture syllabi prepared for those which have none. Lantern-slide circuits are being tried out in Wisconsin, North Dakota, and Texas in cooperation with State officials. By this means sets of slides reach many institutions in succession before they are returned to the office, thus requiring less lost time for transportation. Plans have been developed by means of which illustrative material of various types may be made more available to schools in the several States, especially to help State officials to prepare duplicates of the material.

The beginning of the administration of the Vocational Education Act brought demands for a large amount of service which has been rendered through correspondence or personal conferences. A mailing list of the schools receiving aid has grown rapidly and the requests for assistance have increased in proportion. Not less than 3,000 secondary schools giving bona fide agricultural courses are now on this list.

A memorandum of cooperation between the Federal Board for Vocational Education, the Bureau of Education of the Department of the Interior, and the States Relations Service contemplates a series of investigations under the Smith-Hughes Act, a part of which

shall be conducted by specialists connected with the service. The joint committee representing this cooperative work has already begun the plans for such studies.

A cooperative undertaking with the Bureau of Education resulted in a manuscript on the Vocational Agricultural Education in the Secondary Schools of Six Northeastern States which was submitted for publication by the Bureau of Education. A second manuscript on a survey of two counties in Texas was also submitted to the bureau for publication.

A manuscript has been prepared in cooperation with the State department of education and the State college of agriculture of Ohio for a Manual of Agriculture for the Elementary Schools of Ohio, to be published and distributed by the State department of education. A similar bulletin begun in the preceding year was published by the State department of education of Virginia.

The report of the committee on agriculture of the Commission on the Reorganization of Secondary Education of the National Education Association was compiled in this office and was presented to the reviewing committee in February.

The cooperation with the committee on instruction in agriculture of the Association of American Agricultural Colleges and Experiment Stations was continued, the topic under consideration being "War emergency courses conducted by the agricultural colleges."

A member of the staff continued to act as secretary of the American Association for the Advancement of Agricultural Teaching and the association utilized the office as a clearing house in many ways. Reports on material for visual instruction and on the relation of instruction in general science and agriculture were submitted at the meeting of the association in November, 1917.

The literature on agricultural education which is reviewed for Experiment Station Record was so voluminous as to require a large portion of the time of one member of the staff.

Members of the staff made circuits among the teacher-training institutions for the purpose of giving assistance and to study the problems involved. Incidentally they cooperated in the first campaign of the Food Administration in July and August, 1917. So far as possible the office has made its documents and circulars, as well as its other work, fit into the war emergency campaigns of the department.

INVESTIGATIONS ON FARMERS' INSTITUTES.

J. M. STEDMAN, *Farmers' Institute Specialist.*

At the close of the fiscal year farmers' institutes were still conducted by the State departments of agriculture, the commissioners of agriculture, or special State farmers' institute officials in 15 States, while in the remaining 33 States this activity was entirely in charge of the extension division of the State agricultural colleges as a feature of their regular extension work.

Farmers' institutes in the United States, however, are not rapidly decreasing as a result of this change in management, as is shown by the number of sessions and their attendance. This is surprising, in view of the fact that before the agricultural colleges entered the field the State farmers' institutes included women's institutes, young

people's institutes, railroad instruction trains, movable schools, and other activities which are not regarded as farmers' institutes by the agricultural colleges. Furthermore, these activities have been almost entirely abandoned by the State farmers' institutes, since the cooperative extension act makes generous provisions for these activities through the extension divisions of the agricultural colleges.

Thirty-four States report 6,992 institutes, which lasted 9,436 days, comprised 18,852 sessions, had an attendance of 2,387,928, employed 1,420 lecturers, and cost \$380,071, which was divided between State appropriations of \$252,296 and other funds contributed to the amount of \$127,775.

As in former years, farmers' institute directors and lecturers, as well as county agricultural agents, extension teachers in agricultural colleges, teachers of agriculture in high schools, grange lecturers, boards of health, chambers of commerce, and other extension workers were aided by this office in their work, not only by acting as a clearing house for information respecting similar activities throughout the United States but by material help in presenting their subjects before audiences of farmers and in other ways. Information regarding farmers' institute work throughout the country was collected, tabulated, and published. The 33 lectures thus far published, together with their accompanying lantern slides, have been in great demand and helped in furthering the campaign for increased food production.

The following three lectures, each accompanied by about 50 lantern slides, were published during the year: Renovating the Neglected Apple Orchard, Irish Potatoes, and The City and Suburban Vegetable Garden.

OFFICE OF EXPERIMENT STATIONS.

E. W. ALLEN, *Chief.*

In performing its functions relating to the State agricultural experiment stations this office not only exercises supervision over the work and expenditures under the Hatch and Adams Acts but it aims to aid the stations in a variety of ways. It is the connecting link between the department and the State experiment stations. In a large sense it serves as a central agency for following up agricultural research, giving it publicity and advising regarding its conduct and coordination. It prepares and issues Experiment Station Record, which serves as an abstract journal of the progress of agricultural and allied scientific investigation throughout the world, and it also publishes a card index of experiment station literature, which has been in progress almost from the beginning of the office, and indexes the publications of the stations from their establishment under the Hatch Act. The office also administers the Federal experiment stations in Alaska, Hawaii, Porto Rico, and Guam.

As another means of assisting the stations the office maintains an agricultural science register as an aid in recruiting the station staffs and of bringing adequately trained men in touch with the opportunities which the stations offer. A record is also kept of the progress of agricultural institutions for investigation throughout the world.

RELATIONS WITH THE STATE AGRICULTURAL EXPERIMENT STATIONS.

The general supervisory and advisory relations between the office and the State experiment stations have been maintained essentially as heretofore, with the exception of one station, which was not conforming to Federal requirements and from which it was therefore necessary to withhold the Federal support. This is the only instance of failure of a State to comply with the provisions of the Hatch Act and to correct the conditions when formal attention was called to them.

In its supervisory relations the office represents the department in the general oversight of the expenditure of the funds appropriated under the Hatch and Adams Acts, in order to determine that they are spent in accordance with the provisions of those acts and that suitable conditions are maintained to warrant continuance of the annual appropriations. In carrying out this supervision the office aims not merely to perfunctorily audit the expenditures of the Federal funds, but to examine the relationships of the stations, to see that the work is of a proper scope and character, that the internal administration is effective and adequate, and that the publications are such as are contemplated. Of late years it has also devoted considerable attention to the relations of the stations with the extension work and the public, with a view to giving their results the highest application and usefulness. It maintains close and cordial relations of a sympathetic and advisory nature with all the stations. Its advice is aimed to be constructive and in the interest of the high standards of research and experimentation which the needs of practice and of collegiate and extension work require.

A personal examination of all of the experiment stations was made during the year by representatives of the office, as has been customary in the past. These visits furnish opportunity for conference with the station officers on matters pertaining to policy, activity, administration, etc., and give a direct contact with the members of the station staffs which affords opportunity for discussion of the principles underlying station work and the ideals which should be maintained. These official visits are cordially welcomed by the stations and are an indispensable means of maintaining close contact and promoting mutual understanding.

In addition to this examination of the stations on the ground, the office passes upon all projects proposed to be carried on under the Adams Act, with a view to their approval. This involves a careful study of the various problems involved in the light of their status, of the suitability of the proposed undertaking as a research inquiry, and the adequacy of the methods outlined. These new projects frequently involve considerable correspondence with suggestions for strengthening them, and tend to maintain the high character of research and to constantly improve it. In its attitude account is taken of local conditions which affect the policy and activity of each station, but the effort is made to maintain scientific standards in agreement with those prevailing in research generally.

The past year was exceptional in station affairs, owing to the influence of war conditions. These influences have been felt especially in the effect on the station staffs, which have suffered many losses with increasing difficulty in filling vacancies, and upon the nature

of the station activity. Its work has naturally been directed along emergency lines to a considerable extent, especially in the problems relating to increased production and conservation of the food supply. The station director, from his position in relation to the agriculture of the State, has naturally been called upon to a great extent to direct and assist in the various measures adopted in the State. These activities have necessarily diverted his attention to some extent from the customary administration of the station. The changes in the staff have in many cases involved not only the assistants but the heads of departments, and in a few cases the directorship itself. The office has aided, in so far as possible, in the efforts to keep the station forces intact and to fill vacancies with persons of adequate training and ability.

The great extent to which the results of agricultural investigation have been employed in meeting the present emergency, and have served as the basis for more efficient productive efforts, has emphasized anew the value of the scientific experiments and investigations made possible by the Federal appropriations for the stations during the past 30 years.

The chief of the office has kept in close contact with matters pertaining to organization and administration of the stations, and has continued to serve as a member of the committee on experiment station organization and policy of the Association of American Agricultural Colleges and Experiment Stations.

EXPERIMENT STATION RECORD.

In accordance with the general plan in operation for several years, volumes 37 and 38 of Experiment Station Record, each consisting of nine numbers and the usual author and subject indexes, were prepared during the year. These volumes contain 7,038 abstracts of the world's scientific literature pertaining to agriculture, together with monthly editorials discussing important phases of the developments of agricultural investigation and brief notes on the progress of institutions for agricultural education and research in this country and abroad.

The total number of articles abstracted was practically identical with that for the previous year. Special attention, however, was given to the selection of material of immediate usefulness under the war conditions. Likewise nearly all of the editorial articles took up some phase of the relations of the war to research in agriculture and the response of research institutions in the war emergency.

The primary function of the Record is to systematically assemble, classify, and make readily accessible the vast and widely scattered fund of information daily being contributed to agricultural science. The importance of this function is, of course, intensified under war conditions, since the conservation of the time of teachers and investigators becomes specially desirable.

Increasing difficulty has been experienced in filling vacancies on the staff of Record editors. One member of the staff resigned during the year to engage in chemical work in a war industry, and a second member received a commission in the Engineer Corps. A number of vacancies have been filled by the employment of women.

INSULAR STATIONS.

The experiment stations of this department in Alaska, Hawaii, Porto Rico, and Guam have temporarily put aside many of their projects, or have continued them with a minimum of labor and expense, and have turned their attention to problems connected with food production and conservation. The importance of this work may be seen when it is stated that more than \$30,000,000 worth of foodstuffs are annually imported to these possessions from the mainland. With the increasing demands on the mainland supplies from other sources and the diminishing cargo space available, the situation threatened to become acute. The stations from their beginning had been investigating problems connected with diversified farming, and they were in possession of a fund of information regarding crop production that was immediately put to use. Through various cooperative agencies and through demonstrations, the stations have been actively engaged in disseminating this information and aiding in the present crisis.

No changes were made in the administrative heads of the stations, although many members of the staffs have left for military or other service. Those now in charge of the stations are: Alaska, C. C. Georgeson; Hawaii, J. M. Westgate; Porto Rico, D. W. May; and Guam, C. W. Edwards. To these men is due much of the successful planning and carrying out of the work at the stations.

The appropriations of the stations for 1918 were: Alaska, \$60,000; Hawaii, \$40,000; Porto Rico, \$40,000; and Guam, \$15,000. These sums, together with small balances from sales funds formerly allowed for the maintenance of the stations, constitute their expenditures.

The stations have been greatly assisted by the hearty cooperation of the bureaus and divisions of the department, and acknowledgment of their aid is hereby tendered.

The administration and financial review of the affairs of the stations in connection with the States Relations Service continued, as formerly, under the direction of Walter H. Evans and the accounting office of the service.

ALASKA STATIONS.

Unfavorable weather was experienced throughout Alaska during the autumn of 1917 and the spring of 1918, as a result of which harvesting of crops and preparation of land for planting were greatly retarded. More favorable weather followed, accompanied by a large amount of sunshine, and the crop condition at the end of the fiscal year was considered as very promising.

At the Sitka station the work with hybrid strawberries was continued, and several thousand plants resulting from crosses in which *Fragaria chiloensis* and *F. platypetala* were used as staminate parents are under observation. Plant-breeding work with potatoes is also in progress, the station growing more than a hundred seedlings, some of which appear promising. Particular attention is being paid to the propagation of the economic plants for distribution to settlers, and during the year nursery stock was sent to more than 100 addresses for cooperative testing. A considerable amount of nursery stock is still on hand for distribution.

At the Fairbanks station conditions for crop production were very unfavorable, a cold spring being followed by a severe drought. Even under these adverse conditions, more than 1,200 bushels of spring wheat, oats, and barley was secured. Average yields of over 12 bushels per acre were obtained for spring wheat, the seed for which was obtained in 1914 from a Siberian experiment station. Other varieties yielded from 12 to 15 bushels per acre, and yields of 28 to 54 bushels of oats per acre are reported. Most of the grains grown are from pedigree strains developed at the Rampart station. In an attempt to grow leguminous plants for forage and green manure, it has been found that red clover, which winterkills badly, can be successfully grown as an annual crop when seeded early in May. Potatoes continue to be the principal money crop of the Tanana Valley, and the station reports yields of 92 to 162 bushels per acre.

The Rampart station is continuing its plant-breeding work with great success. A number of early maturing grains have been developed which have become well established. All the alfalfas were winterkilled in 1918, except those derived from *Medicago falcata* and some of the hybrids produced at the station. The Rampart Station and that at Fairbanks are making especial efforts to produce seed for Alaskan use, and in addition to grains, seed of peas, turnip, etc., were grown in considerable quantity for 1918 planting.

The work of the Kodiak station continued as formerly. The herd of cattle, which was found to be infected with tuberculosis in 1916, has been divided, the reacting animals having been removed to Kalsin Bay, where an attempt is being made to build up a sound herd. The station is badly in need of better barns which can be kept in a more sanitary condition.

The Matanuska station is being developed, a small area having been prepared for cropping and the necessary buildings and fences having been erected. About 12 acres was planted in 1918 to grain crops, potatoes, and vegetables.

During the past year cooperative work with settlers was undertaken on a larger scale than ever before. Especial attention was given to the Matanuska Valley and the region around Knik and Anchorage. Personal visits were made to many ranches, and a half ton of seed grain was distributed with directions for planting. A number of the cooperators reported upon their trials, and in many instances grain was matured and saved for seed. In the spring of 1918 more than 4½ tons of seed grain, as well as a large amount of nursery stock and vegetable seeds, were distributed among the homesteaders of this region, many of whom are wholly ignorant of how to care for such crops, though most of them are eager to make trials under the station's direction. A farmers' cooperative association was organized in the Matanuska Valley, and most of the settlers have already joined it. Similar work in the Tanana Valley is contemplated.

HAWAII STATION.

The work of the Hawaii station during the year was confined to problems connected with the production and utilization of food crops, many of the more technical projects having been held in abeyance while every effort was made to develop new industries and to famil-

iarize the public with some of the more practical results of previous investigations. Hawaii is a large importer of foodstuffs, the value of these imports amounting in 1917 to more than \$10,000,000, and with the disarrangement of shipping as well as the demand on mainland supplies incident to the war, the food situation during 1917-18 became acute. The station, through its technical and extension staffs, has freely cooperated with individuals, military posts, and organizations throughout the islands. Vacant land was turned over to the station laborers, who were encouraged to grow war gardens not only to supply their own needs but to serve as demonstrations of methods of cultivation, spraying, etc. At the principal military posts gardens planted under the supervision of the station gave excellent results. Late in the year a Territorial fair was held in Honolulu, in which the station took a prominent part. The fair furnished an opportunity of showing the results of agricultural propaganda work conducted for several years, and exhibits were supplied by about a dozen nationalities. An interesting feature was the daily exhibition of foods of people of various nationalities, especially the Japanese, Chinese, and Hawaiians, who demonstrated such of their native foods as they considered best adapted for use as substitutes for wheat and other imported articles of diet. Mrs. J. M. Westgate, cooperating with the station, worked out a method of substituting about 30 per cent banana pulp for wheat flour in bread making. This practice, taken up by the bakeries of Honolulu, has resulted not only in a saving of flour but in the finding of a use for the surplus of bananas following the removal of steamships from mainland transportation routes.

The horticultural work conducted during the year with fruits and vegetables was concerned especially with the increased utilization of the banana, papaya, and tomato as food crops. A comprehensive test of beans was made to determine the best varieties for commercial canning, the work to be done by the pineapple canneries during the season of lessened activity. The chemists have paid attention to the drying of Hawaiian fruits and vegetables in order to find a method of utilizing supplies from temporary overproduction, and some very practical methods have been worked out that are adapted to local conditions. A compilation of all available analyses of Hawaiian feeding stuffs was published to supply information relative to the value of locally produced materials. As a result of the successful control of pineapple yellows by spraying with iron sulphate solutions at least 7,500 acres has been added to the area devoted to pineapples. The plant pathologist has given much time and effort to demonstrating the possibility of controlling certain diseases. The largely increased potato production of the islands is due to a considerable degree to proper spraying. A destructive banana disease and a rot of taro are being studied in an attempt to work out practical methods of control. The agronomy division has directed its efforts along the line of forage production for animals and food production for man. A variety of corn from Guam that is a good yielder and is also resistant to leaf hoppers is being exploited by the station. The edible canna, the tubers of which may be substituted for potatoes in the diet, is being propagated and distributed as rapidly as possible. The forage-crop work conducted for the Army

at Castner is making fairly good progress, it having been found that sorghums and pigeon peas grow rapidly in the manganese soils of that region.

The extension work of the station has been correlated with that of the Territorial food administration to a considerable extent, the superintendent of extension acting for a time as county agent for Maui. The demonstration work inaugurated by him at Haiku has given much valuable data for the use of the extension force. The demonstration farms of the station are being widely observed, and the agriculturists and the canning and packing interests of the islands are beginning to place great dependence on the results secured on these farms.

PORTO RICO STATION.

The work of the station during the year consisted quite largely of efforts to stimulate increased food production. The chemists continued their investigations on soil and fertilizer problems, a bulletin on the Bat Guanos of Porto Rico and Their Fertilizing Value having been issued during the year. Experiments have shown that sugar-cane chlorosis is due to the fact that calcium carbonate depresses the availability of iron below the amount needed by the cane. The incorporation of organic matter, as stable manure, with the soil has been found to correct the trouble to some extent. Particular attention has been given the phosphate requirements of soils, vegetation experiments with a large number of type soils having been conducted during the year. In the horticultural work especial efforts have been made to improve native crops and to introduce new or better varieties. This applies to sweet potatoes, yams, mangoes, citrus fruits, coffee, cacao, vanilla, etc. The possibility of establishing vanilla growing as an industry seems assured, and several cooperating planters have been furnished sufficient cuttings to demonstrate the commercial possibility of the industry. The experiments on coconut fertilizers, intercropping, and cover crops have been continued with some promising results. The plant-disease and plant-breeding experiments were interrupted by the leaders entering military service early in the year. In entomology the investigations on the changa were completed and a bulletin issued on the subject. Work on the life history of the May beetle has been begun. Interest in the eradication of cattle ticks has been aroused, and some cooperative work has been begun. The station grounds have been freed from ticks, and the insular government has become impressed with the importance and benefits to be derived from the eradication of the tick.

In addition to the investigations carried on, a large amount of demonstration and extension work was done to arouse the people to the importance of greater food production. Practically every member of the station staff gave some or all of his time to this work. In cooperation with the insular food commission, the entire island has been districted and organized for increased production of food. Many acres of idle land have been planted to food crops, and in some localities sugar planters have allowed their laborers to plant beans between the rows of young cane. So successful were the efforts with this one crop that Porto Rico has become an exporter of beans instead of a heavy importer. As a result of the food-production

campaign it is reported that the area devoted to food crops was increased by 43 per cent. Large areas usually devoted to a second tobacco crop were planted to corn and beans. It is estimated that more than 25,000 domestic gardens were planted during the year. Cooperative work in rice growing has been begun, about 60 acres being grown in different parts of the island to determine the possibility of developing this industry. Porto Rico imports about \$5,000,000 worth of rice annually, and it is believed that at least half of this amount could be locally produced. An experiment in winter production of garden seeds was begun, but the work was inaugurated so late in the season that no definite results were obtained. In cooperation with the Bureau of Chemistry of this department, experiments on the utilization of citrus by-products were undertaken with such successful results that a cooperative organization has been formed to manufacture them on a commercial scale.

GUAM STATION.

The Guam station reported satisfactory progress during the year. It assisted in inaugurating the first industrial fair held on the island, this proving a success in every respect. Exhibits of stock and agricultural products were made by the station to show the superiority of improved live stock and new and better food crops. Such exhibits are believed to have an educational value and, by stimulating interest in the station's work, to bring about an improvement in the general condition of the people. This fair was held early in the fiscal year, and as one of its results there were more requests on the station for seeds and plants than ever before. During the past year more than 50,000 plants, 7,182 lots of vegetable seed, 59 pounds of leguminous cover-crop seeds, 251 sacks of grass roots for planting, and a larger number of kafir heads were distributed in the island. Guam is so situated that the station is about the only source of seeds and plants, and through a cooperative arrangement with the insular government directions are given for planting and supervision of the crops is maintained. Through this means the efforts of the local government for greater food production have been aided. Many farmers in Guam are beginning to save their own seed, being aided and advised by the station in supplying their necessities in this line as far as possible.

The work with the live stock progressed very satisfactorily. On September 27, 1917, by agreement with the naval governor, 1 stallion, 3 mares, and 2 fillies were transferred to the naval establishment. The transfer relieves the station of the expense of their maintenance and at the same time makes the animals available for breeding and experimental purposes. The breeding and feeding experiments with cattle and swine were continued during the year. The early promise of value of the introduced Para and Paspalum grasses for stock pastures is being maintained. The breeding and feeding experiments with swine are attracting much attention, and the station is unable to keep up with the demand for breeding stock. In a comparative test a lot of grade pigs made average gains of 78.7 pounds, as compared with 37.8 pounds for a lot of native pigs of the same age receiving the same ration. Experiments like this are readily

understood and appreciated by the natives. The experiments in progress with poultry include breeding and incubation work. Additional breeding stock is needed to enable the station to resume its cross-breeding experiments with native breeds. An effort to add to the breeding stock of the station was defeated by transportation difficulties.

The agronomy work was retarded by abnormal rainfall, and many of the crops suffered by reason of insect attacks. Practically all the rice in the plats was destroyed in this manner. Among the forage plants investigated, kafir, darso, Sudan grass, and sorghums are giving excellent promise of being adapted to Guam conditions; and among the green manure and cover crops, velvet, jack, and mungo beans and cowpeas are all proving valuable; but as the natives are said to be interested only in crops that also yield food, the results with mungo and soy beans and cowpeas are looked upon more favorably by them than those with plants that give a heavier production of vines, as velvet and jack beans. The work with cotton is being continued, and in the experiments in corn improvement the eighth generation of corn has been planted. The work with tobacco has again shown the necessity of spraying with lead arsenate to secure undamaged leaves. A series of soil experiments has been begun to determine the fertilizer requirements of certain typical soils.

The horticultural work consists of propagation of tropical fruits and of vegetable-garden demonstrations. Considerable losses are reported as due to certain diseases of vegetables. In cooperation with Mrs. Vallie P. Briggs the station has begun trials of native and introduced fruits to determine methods for their utilization and conservation.

Late in the year W. H. Weston, of the Bureau of Plant Industry of this department, visited Guam and made a survey of the plant-disease situation. While no epidemics of plant parasites were noted, the desirability of adding a plant pathologist to the station staff and of establishing adequate quarantine regulations was pointed out in his report.

Just after the close of the fiscal year Guam was visited by a very destructive typhoon, wind velocities of 130 miles per hour being reported. There was little loss of life, but all crops were destroyed. The station suffered much damage to its buildings and fences, the poultry plant being practically destroyed.

VIRGIN ISLANDS STATION.

With the incorporation in the appropriation bill for this department of provision for an agricultural experiment station in the Virgin Islands of the United States, preliminary arrangements were made for taking over the station established on St. Croix by the Danish Government. Under existing ordinances the director of the station, in addition to performing the usual duties of such an office, acts as adviser to the governor on all agricultural matters. Through an understanding with the governor no change in this policy is contemplated. With the passage of the appropriation bill the station will be taken over and administered by this department.

The agricultural experiment station on St. Croix was established in 1910, following a visit by the superintendent of agriculture of Bar-

bados at the invitation of the Danish colonial government. Active work was begun in July, 1911, when the present director assumed office. A tract of 23 acres $2\frac{1}{2}$ miles from Christiansted was purchased, on which an office and a laboratory building of concrete were erected. This area was added to in 1914, the station tract now embracing 215 acres, 170 of which is in cultivation. The area under cultivation has been laid out into permanent plats and fields, and systems of cropping and methods of using fertilizers are being studied. The principal crops under investigation are sugar cane and cotton, with considerable attention to forage and green-manure crops. In connection with the sugar-cane and cotton investigations, plant-breeding work is in progress, and some valuable seedling canes and hybrid cottons have been produced. In addition to the field work described above, considerable attention is being given to plant diseases, insect pests, chemical investigations, etc.

OFFICE OF EXTENSION WORK IN THE SOUTH.

BRADFORD KNAPP, *Chief.*

J. A. EVANS, *Assistant Chief.*

The cooperative agricultural extension work as now organized in the 15 Southern States is conducted along the following lines:

- (1) Administrative work in carrying out the provisions of the cooperative agricultural extension act of May 8, 1914.
- (2) Extension demonstration work through county agents.
- (3) Extension home demonstration and girls' club work through women county agents.
- (4) Extension demonstration work through boys' clubs.
- (5) Extension demonstration work of specialists through county and women agents.
- (6) Extension demonstration work for negroes, including boys' and girls' clubs for negroes.
- (7) Extension work through special agricultural campaigns.

This work is carried on in cooperation with other bureaus of the department, the State agricultural colleges, the counties, and the State and local organizations.

ADMINISTRATION.

The administration of the Office of Extension Work in the South is in charge of a chief and 1 assistant chief. They are assisted by 4 field agents in the administration of county agent and all cooperative extension work in the State; 4 men and 4 women in the administration of home demonstration and boys' and girls' club work; and the necessary office assistants and clerical force. There are also 10 joint representatives of the Office of Extension Work in the South and other offices or bureaus of the department who assist in the supervision of the work of the cooperative specialists in the various States.

Visits were made to each of the State agricultural colleges to inquire into the work under the approved Smith-Lever project agreements. Full reports on the condition of the work and the results obtained in each of the 15 States were prepared.

Representatives of the office attended and assisted in conducting annual and semiannual meetings of county agents, home-demonstration agents, and other extension workers in each State. The office

staff also attended and addressed many other meetings of importance in the development of agriculture and home economics in the South during the year. Representatives of the office made special trips into all the States during the year to advise with the extension forces and to visit field demonstrations with the agents.

A large number of circulars were prepared and distributed and special campaigns were conducted for the purpose of emphasizing the need of greater production of food and feed stuffs in the South and the necessity of conserving the surplus by canning, drying, and storage.

COUNTY AGENTS.

The appropriations made from State and county funds for the support of county-agent work have been more liberal during the fiscal year just closed than in any previous year. The total amount of money from all sources devoted to county-agent work in the 15 Southern States in 1917-18 was \$1,444,099.75. The total county appropriation for the year over and above the Smith-Lever offset in the Southern States amounted to \$656,714.57.

Great difficulty was experienced during the year in finding men with practical training and experience for county agents. A large number of agents of draft age have voluntarily given up county-agent work to enter the Army. The loss to the Army of trained workers from the county-agent force has in a measure handicapped the efficiency of the work, as it is practically impossible to find a sufficient number of well-trained men to take their places.

ORGANIZATION.—The progress of the organization of county-agent work in the South has been very rapid. Great advantage was taken of the war spirit, which has stimulated a desire upon the part of the people to organize for all purposes. Under this stimulus practically every county where there is a county agent has an organization through which he carries out the agricultural program and assists generally in campaigns and in other war work.

In one State—namely, West Virginia—these organizations are known as farm bureaus, but in that State the farm bureau is supplemented and supported by a very fine system of community organizations, and the officers of these community organizations really constitute the county organization. The general plan of organization in all Southern States consists of, first, community organization, and, second, the federation of these into a county organization. Where the system is working perfectly the members of the county organization are either the officers of community organizations or elected delegates from them. Where the system has not been put into perfect shape the place of a community organization may be occupied by a committee pending the perfecting of a community organization. Since the great growth of the councils of defense fostered by the Council of National Defense, in many counties of the South the organizations have all been consolidated, and the community and county councils of defense constitute the working organizations of the county agent. In two of the States an added part of the organization was the appointment of special representatives or collaborators to act as committeemen to carry out campaigns. In one State several were appointed for each county; in another the number ap-

pointed in some counties was large enough to reach every farm in the county.

Community organizations have been on the increase the last few years, as shown by the following statement:

Community organizations, 1915-1917.

	1915.	1916.	1917.
Membership-----	44,548	78,660	113,316
Farmers' or community organizations--	1,712	2,508	3,507

Without the war-time increase in organization it is estimated that there were between 5,000 and 6,000 community organizations with a membership of somewhere between 300,000 and 500,000.

Besides the organization mentioned, in some counties the county agent has the organized and most helpful assistance of farmers' unions and church and civic organizations of various characters.

PLAN OF WORK.—In the work in the South the county agent is recognized as the leader in all of the agricultural extension activities in his county. In many of the States a written plan of work for the year is prepared by the county agent, subject to the approval of the cooperative extension authorities. This includes a program of demonstrations, both personal and community; special campaigns; field meetings; organization work; organization of boys' club work; and special demonstrations conducted in cooperation with the specialists in the extension division. Boys' club work is an important feature of each county agent's activity.

There were employed in the 15 Southern States during the year 1,156 county agents, of which 723 were employed from emergency funds. Each State has a director of extension and a State agent or assistant director in charge of the work of county agents. There were employed 72 district agents to supervise the work of the county agents and 88 boys' club supervising agents to supervise the boys' club work.

RESULTS.—During the season of 1917-18 almost the entire effort of the county agents was directed toward increased production of food and feed and the general support of agriculture under war conditions. The situation was a difficult one, especially in all the great cotton territory of the South. The highest price for cotton recorded in the last 50 years prevailed during the entire planting season. Under the general direction of the Office of Extension Work in the South, a campaign for war-time production and "safe farming" was conducted in every Southern State. The program was, briefly, as follows: A home garden for every family, with plenty of potatoes and sorghum or sugar cane for sirup; increase of the great feed and food crop, corn; increased production of small grains; production of enough hay to supply the live stock of the South; peanuts in sufficient quantity to feed the increased hog production; velvet beans, soy beans, cowpeas for hogs and cattle, as well as to add fertility to the soil; production of enough meat, milk, and eggs to supply the needs of the South; in other words, the production of the food of the South on the farms of the South with the cotton as a surplus cash crop. The results in planted acreage show the effectiveness of the campaign.

The following table shows the acreage in terms of per cent of the 1917 acreages for each of the Southern States for some of the principal farm crops and per cent of increase in the number of live stock:

Comparative acreage of crops and number of live stock in the South in 1918 and 1917.¹

State.	Acreage in 1918 in per cent of 1917 acreage.						Numbers of live stock in 1918 in per cent of those of 1917.		
	Corn.	Oats.	Hay (tame).	Pota- toes.	Sweet pota- toes.	Cotton.	Hogs.	Cattle.	Sheep.
Alabama.....	97	108	112	168	107	130	121	112	119
Arkansas.....	101	130	103	104	92	104	119	114	113
Florida.....	116	100	104	135	110	89	102	108	120
Georgia.....	102	91	100	120	103	102	125	114	124
Kentucky.....	100	100	110	94	94	.....	107	104	122
Louisiana.....	105	95	100	200	97	106	102	113	149
Maryland.....	102	102	107	86	100	.....	101	102	112
Mississippi.....	100	86	87	133	105	116	125	117	129
North Carolina.....	100	102	101	97	90	103	107	104	110
Oklahoma.....	91	110	101	103	101	109	80	104	108
South Carolina.....	98	135	100	125	100	104	119	110	113
Tennessee.....	96	100	110	85	95	102	121	104	116
Texas.....	100	106	100	112	104	102	85	91	118
Virginia.....	104	105	105	83	96	97	105	107	113
West Virginia.....	103	104	101	99	100	.....	100	106	110
Total.....	101	105	103	116	100	105	108	107	118

¹ Compiled from U. S. Dept. Agr., Mo. Crop Rpt., 4 (1918), Nos. 6, 7, 8.

In the season of 1917-18 approximately 303,723 adult farmers conducted demonstrations in one or more lines of farm work at the suggestion and under the supervision of county agents. The total acreage in these demonstrations was as follows:

Corn, 799,476 acres; cotton, 501,729 acres; wheat, 156,660 acres; rye, 68,769 acres; soy beans, 77,597 acres; velvet beans, 540,448 acres; alfalfa, 44,526 acres; peanuts, 100,505 acres; Irish potatoes, 14,809 acres; sweet potatoes, 11,178 acres; miscellaneous forage crops for hay, soil improvement, etc., 364,741 acres.

Some of the miscellaneous activities of the county agents in assisting the farmers were as follows: Pruning and spraying 635,864 trees in home orchards as demonstrations to show the value of pruning and spraying; conducted feeding demonstrations with 18,598 head of beef cattle; brought into the territory 58,007 beef cattle for breeding purposes; conducted 30,041 demonstrations in the feeding and management of swine; assisted in building 2,256 dipping vats and 5,517 silos; instructed 56,031 farmers how to care for farm manure; conducted 25,068 demonstrations with lime; advised 156,804 farmers in regard to the proper use of commercial fertilizer; furnished building plans for 3,028 farm buildings; installed 1,753 home water systems; put in 28,812 tiling demonstrations and 20,439 terracing demonstrations; 315,654 home gardens were planted or improved through the work of county agents. The agents made 885,966 farm visits and received 765,207 calls at offices or homes. Addresses were made at 78,996 meetings with a total attendance of 3,880,403.

DISTRESSED CATTLE.—Severe drought in west Texas in 1917 continues in 1918 with increasing intensity. Through cooperation with

the Bureau of Animal Industry and the Bureau of Markets, the county agents in Texas cooperating with county agents in Louisiana, Alabama, Georgia, Oklahoma, Mississippi, Arkansas, and Florida, assisted in directing farmers in regions of heavy crop production to obtain cattle from the drought-stricken regions of Texas, resulting in the transportation of about 300,000 head under this arrangement.

THE DROUGHT.—The drought of 1918 has been much more severe than that of 1917 and has affected not only Texas and Oklahoma, but has extended into Louisiana, Arkansas, Mississippi, parts of Alabama, Tennessee, and Kentucky. The entire crop-production program of the Southern States has been disturbed, except in some of the extreme Eastern States.

Finally, the county agent has not only been a leader in outlining and promoting the agricultural program for his county to meet the war needs, but has also assisted in all patriotic movements; in the sale of liberty bonds and war savings stamps, the Red Cross campaign, and similar war activities among the farmers of the country.

HOME DEMONSTRATION AND GIRLS' CLUB WORK.

It should be understood that in the South the girls' club work is handled by the home-demonstration agents, while the boys' club work is handled by the men county agents. In 1917-18 season there were 1,232 women agents in the 15 Southern States, of which 849 were employed on emergency funds. Many of these were not put on until the spring of 1918, and hence the full effect of the work can not be outlined. The report for 1917-18 is based on reports from 715 counties.

A slightly different plan of work was inaugurated in 1917 under war conditions, both in the women's work and in the girls' club work. The regular work of enrolling and training women and girls in groups by having them conduct demonstrations was continued as a regular activity, but at the same time every effort was made to enlist a large emergency enrollment. For example, the regular enrollment of women in 1917 was 82,227 in 3,812 different clubs. The emergency enrollment, receiving instructions through the county home-demonstration agents, and the local volunteer leaders, selected mainly from the regular enrollment, reached 1,470,408. In the work for girls the regular enrollment was 73,306, while the emergency enrollment of girls receiving instructions from county home-demonstration agents was 980,272, making a grand total of women and girls enrolled 2,606,213. Federation of women's clubs, civic and church organizations of women, and many women's organized war activities assisted in obtaining this large enrollment. The whole plan was an organized effort to reach the largest possible number of women with definite instruction on food production, such as gardening, poultry raising, etc., food conservation, such as canning, drying, brining, and preservation of fruits, vegetables, and meats; the manufacture of dairy products, such as butter making, cheese making, etc., and the use of foods made necessary as substitutes under war conditions, such as the wheat-saving, fat-saving, and sugar-saving work. Under the influence of this work in its assistance to the Food Administration, many sections of the South voluntarily gave up the use of wheat

entirely during the spring of 1918 and did not use wheat until the new crop had been harvested.

RESULTS.—In regular work the women enrolled put up 34,993,677 cans of vegetables and fruits for future use. The value of this product was more than \$7,000,000. They produced over 5,500,000 pounds of dried vegetables and fruits for future use; and brined, pickled, and otherwise stored more than 1,000,000 pounds of vegetables; while the girls in their regular enrollment canned over 8,882,000 cans from their one-tenth acre gardens, which were part of the regular requirement. The value of these products is over \$1,500,000. They also put up over 3,961,000 containers of vegetables and fruits from the farm and orchard outside of their one-tenth acres. It is estimated that gardening increased by 500 per cent in the South in the last year, owing to the campaign among women as well as that referred to on the preceding page.

The emergency enrollment is estimated to have added a sufficient number of cans to make the grand total of the whole organization practically 200,000,000 cans of fruits and vegetables put away for future use. In many sections of the South disinterested public men on investigating reported five times as much in the pantries and store-rooms of southern homes as in any other one year in the past 50. Those who have known the South intimately for the last 10 years will testify to the great results accomplished and the changes brought about by this work. Ten years ago canning, while practiced by some, was a rare exception, and the garden was conspicuous by its absence. During the past year canning has been the rule and the failure to can a rare exception, while practically every home had a garden.

In addition to these lines of work, homemade fireless cookers were put into a large number of homes, labor-saving devices of various kinds were introduced, egg circles for the marketing of eggs were organized and put into operation, and many other things were done to improve the health, the diet, the food supply, and the productive power of millions of southern homes.

BOYS' AGRICULTURAL CLUBS.

Boys' agricultural clubs were carried on by State, district, and county agents cooperating with school officials and business men. The number of boys enrolled in 1917 was 115,746, classified by clubs as follows: Corn, 40,394; potatoes, 3,441; cotton, 5,297; grain sorghum, 2,126; peanut, 3,157; calf clubs, 2,968; pig clubs, 31,375; poultry clubs, 11,633; and miscellaneous clubs, 4,087. The enrollment has been greatly increased in 1918, and it is expected that in addition to the regular enrollment there will be an emergency enrollment of 400,000 club members. Many farm boys under the age of 18 are being instructed by club agents and county agents in doing a man's work on the farm. The emergency enrollment is an effort to get hold of all boys who are taking on the added burdens of the war time and to give them credit for their extraordinary efforts.

The average yield of corn by the members of the boys' clubs throughout the 15 Southern States was 47.97 bushels per acre. There were 110 boys who made more than 100 bushels per acre, and some good records were made by boys in other farm crops.

Farm makers' clubs for negro children were organized during the year in several of the States. Much work has been done every year in these States among the negroes, but the work was greatly enlarged during the past year.

Pig clubs conducted in cooperation with the Bureau of Animal Industry are very popular. Thousands of pure-bred pigs have been distributed among the boys with excellent results. Pure-bred hogs are becoming well distributed throughout every part of the South.

Short, practical courses in agriculture for club boys are held in each county, where all the club members attend and receive instruction. In addition to the short courses held in the counties one is also held at the agricultural college where the prize winners are brought for a week or two weeks' instruction. The boys' clubs are stimulating farm boys to enter the agricultural colleges to continue their agricultural training. In one State in 1917, 218 club boys entered the agricultural college. The club work is not only furnishing valuable instruction to farm boys throughout the South, but is also providing a valuable means of increasing food production.

SPECIALISTS.

In addition to the county agents in the South, there is a force of 259 specialists in agriculture and home economics traveling from the State agricultural colleges and the different bureaus of the department. Their main function is to assist the county agent along special lines of work. They outline demonstrations, assist the agent in establishing demonstrations, and in holding meetings. They prepare technical bulletins for distribution to farmers, answer correspondence at the headquarters on technical matters, and organize and assist in campaigns when such are necessary. The prevention of spread of plant and animal diseases, the eradication of insects, the advice and counsel on problems in marketing, introduction of new and untried crops, and many other lines of activity are supervised by these specialists.

In the Department of Agriculture close contact has been established between the subject-matter divisions of the department and the Office of Extension Work in the South. At the present time this arrangement has been perfected with eight different divisions, as follows: Office of Horticultural and Pomological Investigations and the Office of Truck Crop and Cotton Diseases, Bureau of Plant Industry; the Office of Farm Management; Bureau of Markets; Bureau of Animal Industry in animal husbandry and poultry husbandry; Dairy Division, Bureau of Animal Industry; Bureau of Entomology in general insect pests and in bee keeping; and the Forest Service. Under this arrangement generally the salary of the specialist is paid from the subject-matter division and his travel when engaged in extension work is paid by the Office of Extension Work in the South. Such specialists when in the field represent and are responsible to the subject-matter division as to all subject matter, and to the Office of Extension Work in the South as to extension method and policy. They have their contacts in the field and go to the States to help unify and carry out the work on a broad basis. They are the go-betweens of the department subject-matter heads and the State subject-matter heads, and assist in unifying the work in each of the States.

NEGRO WORK.

There were on June 30, 1918, 142 negro men agents, 83 of whom were employed on emergency funds, and 194 negro women agents, 153 of whom were employed on emergency funds. The negro agent as a rule is appointed assistant to the white county agent. Under this plan the regular county agent has general supervision of the work.

Cooperative relations have been perfected in most of the States between the negro agricultural college and the extension division. The leader in charge of the negro agent work has his headquarters at the negro agricultural college. Negro agents have been very effective in the past year in stimulating the growing of more food crops, giving special attention to the home garden, and to canning and drying of fruits and vegetables for home use. They have also materially assisted in helping in the labor problem by urging the negroes on the farms to work six days in the week.

OFFICE OF EXTENSION WORK IN THE NORTH AND WEST.

C. B. SMITH, *Chief.*

L. A. CLINTON, *Assistant Chief.*

ADMINISTRATION.

The Office of Extension Work in the North and West is charged with general administrative duties, as follows:

(1) The formulation of plans, the supervision of work, and the expenditure of funds under direct appropriation of Congress to the office for "farmers' cooperative demonstrations outside the cotton belt."

(2) The consideration of plans for cooperative extension work in agriculture and home economics as submitted by the 33 States of the North and West, and the administration of the provisions of the cooperative extension act of 1914 as they apply to these States.

(3) The consideration of plans for extension work by the various bureaus of the department having funds for this work, and the correlation and adjustment of these plans in so far as practicable with those submitted by the States.

(4) The administration of special war emergency funds provided by act of Congress for increasing food production and eliminating waste, and promoting conservation of food in the Northern and Western States.

In all the department's extension activities in the States, the terms of the memorandum of understanding entered into between the department and the State colleges of agriculture have been closely observed. This memorandum provides that the extension work of the department in each State shall be in cooperation with the State agricultural college, and performed under the immediate supervision of the director of the State extension service, who assumes responsibility for the direction of the department's work in the State as well as for that of the State workers, thus making it in effect one piece of work.

The problems of administration during the year were greatly increased through the stimulation of activities of various organizations for war work, and because of the many new problems arising for solution. Through frequent conferences in the States, and in Washington, the needs of the States have been made known, and plans agreed upon for meeting these needs. Through the stimulation of the county-agent work, the work of home-demonstration agents, and

the boys' and girls clubs, crop production was increased and foods conserved.

The administrative section of the office directly considers all matters relating to the administration of funds under the various projects, correspondence relating to finances and relationships, and the adjustment of all questions arising under the memorandum of understanding.

For the consideration of details of administration under the various projects the office is organized as follows:

- (1) Cooperative relationships and projects.
- (2) County agricultural agents.
- (3) Boys' and girls' club work.
- (4) Farm-management demonstrations.
- (5) Extension work with women.
- (6) Extension specialists.

Plans for work having been agreed upon for the year, and assignment of funds having been made to the various projects and the States, in accordance with the best interests of the work, details of administration are then considered by the special section of the office involved.

COOPERATIVE RELATIONSHIPS AND PROJECTS.

This section, in charge of L. A. Clinton, with D. W. Working in immediate charge of projects, has responsibility for the consideration of plans for cooperative extension work in agriculture and home economics, as submitted by the following States: Arizona, California, Colorado, Connecticut, Delaware, Idaho, Illinois, Indiana, Iowa, Kansas, Maine, Massachusetts, Michigan, Minnesota, Missouri, Montana, Nebraska, Nevada, New Hampshire, New Jersey, New Mexico, New York, North Dakota, Ohio, Oregon, Pennsylvania, Rhode Island, South Dakota, Utah, Vermont, Washington, Wisconsin, Wyoming.

Plans or projects are examined; proposed distribution of funds noted; plans for extension work contemplated by the various bureaus of the department are examined and department and State extension plans coordinated; conferences are arranged and reports prepared. Each of the 33 States is visited annually, and the vouchers for the Smith-Lever funds are examined, conferences held with the extension director and the members of the extension staff. Progress of the work is noted and needs for adjustment are determined.

From the 33 States 568 projects or plans for extension work were submitted for consideration and approval; and from within the department itself about 150 projects were submitted for the year ending June 30, 1918, for coordination with State plans.

COUNTY AGENTS.

The county-agent work was conducted as last year with W. A. Lloyd in immediate charge. During the year the number of counties employing agents increased from 544 on June 30, 1917, to 1,103 on June 30, 1918. The following States have completed their quotas for agents: New Hampshire, Vermont, Connecticut, Massachusetts, Rhode Island, Delaware, Iowa, Minnesota, and New York. Eighty per cent of the agricultural counties were reached by county or dis-

trict agents. Farm bureaus, which were originally organized primarily as an aid to the county agent in his demonstration work, have come to be recognized generally as the county extension organization. Cooperating with the State agricultural college and the United States Department of Agriculture in all the extension work being done by each of these institutions in the county, these associations are now developing county programs of work in agriculture and home economics. During the year the number of farm bureaus increased from 278 to 775, there now being a total membership in farm bureaus of 300,000.

AGENTS STIMULATED FOOD PRODUCTION.—Among the principal handicaps met by the farmers in their efforts to increase crop and live-stock production have been the difficulty of securing sufficient farm help and the necessary and desirable fertilizers, seed grain, and seed potatoes. The county agents assisted 132,205 farmers in securing or locating 2,615,497 bushels of seed grain, beans, and seed potatoes, including more than half a million bushels of seed corn for the 1918 crop. As a direct result of this campaign 3,478,982 additional acres are reported to have been planted with those crops for which the Government has felt the greatest need for meeting the threatening food shortage, both of this country and the allies. The increased production brought about primarily through the efforts of farm-bureau committeemen and the county agents is reported to have been 32,767,756 bushels of crops and 272,746 tons of forage.

FARM HELP SECURED.—The farm-bureau offices or county agents received 65,095 applications for farm help and assisted in securing or placing 66,036 laborers, including more than 3,000 women and girls, used principally in harvesting fruit. In order to meet the labor difficulties on farms, the agents arranged to assist in locating and placing farm laborers by keeping lists in their offices of those wanting farm help and those desiring work. In many instances the agents have cooperated with State labor agents in having a farmer in each community serve as committeeman on labor supply. These committeemen reported to the county agents help needed and available in their communities in excess of local needs and supply, and the county agent, in turn, reported to the State leader the number of laborers needed in the county which could not be supplied locally.

DEMONSTRATION WORK PAYS THE FARMER.—In doing their work the county agents in the 33 Northern and Western States arranged for and supervised 34,613 demonstrations, either to show methods or results, involving 2,084,589 acres of crops and 149,820 head of live stock. In connection with these demonstrations 13,047 meetings were held to acquaint farmers with results of demonstrations, attended by more than 400,000 persons. On 16,370 demonstrations which it was possible to follow up closely to determine results based on definite records the agents report more than \$4,500,000 profit to farmers, due to increased production or saving resulting from following methods recommended. A great many demonstrations have also been conducted for which no definite money value could be assigned. Others are continued more than one year, and many are never brought to final conclusion on account of drought, frost, and other conditions preventing their completion.

SEED-CORN SELECTION AND TESTING CAMPAIGNS.—Three hundred and fifty-four agents assisted 63,813 farmers in fall-selecting seed corn, and more than a million additional acres were planted with fall-selected seed corn, resulting from work of the agents in the fall of 1916. Assistance was given to 36,538 farmers in the testing of seed corn, resulting in 946,563 additional acres being planted with tested seed. The most extensive campaigns to encourage seed-corn selection in the fall and seed-corn testing were carried on in Illinois, Indiana, Iowa, Michigan, and Pennsylvania.

In the spring of 1918 the corn-belt States were faced with the worst seed-corn situation in their history. Early frost in 1917 had caught much of the corn immature. This was followed by unseasonably warm weather after corn was harvested, which rendered much of the original testing unreliable. The situation was especially bad in the northern part of Ohio, Indiana, Illinois, and the whole State of Iowa, as well as in the northern extension of the corn belt in South Dakota, Minnesota, Wisconsin, and Michigan.

Surveys were conducted by the county agents through their farm bureaus and showed in many counties a total absence of seed, and that in the aggregate many million bushels were needed to plant normal acreage. In Iowa alone the survey showed that more than a million bushels of seed would be needed. Farm bureaus organized testing stations. All available corn of the 1916 crop was located. This was found to be in good seed condition for the most part. Careful methods of distribution were mapped out and every effort was made to meet the situation from seed known to be adapted to the locality so far as possible. The Seed Stocks Committee of the Department of Agriculture rendered valuable service, particularly in locating State supplies of seed corn and in facilitating distribution. Through intensive organization in Iowa sufficient seed was located within the State, so that there was no need for imported corn. Indeed, practically every farmer was supplied with seed known to be adapted to his own farm. In some other States it was necessary to go out of the State to secure seed. All imported seed, however, was carefully tested for germination, and so far as possible was secured from such varieties and latitudes as would tend to reduce the risk of importing seed to the minimum.

The organization and the carrying out of these campaigns, which resulted in making possible a large crop of corn in a critical year, was only possible through the trained leadership of the county agents and the cooperation of farm-bureau committees.

SEED TREATMENT FOR OAT-SMUT CONTROL PROFITABLE.—More than 50,000 farmers cooperated with the agents in treating seed oats for smut, resulting in more than 1,000,000 additional acres of oats being sown with treated seed. Based on 1916 reports, the results of this work increased the yield an average of about 4 bushels per acre, and this increase was brought about in most cases at a cost of less than 10 cents per acre.

POTATO AND ORCHARD DISEASES.—Twenty-three thousand three hundred and six farmers were encouraged to select or treat their seed potatoes for the control of scab and other potato diseases, resulting in nearly 100,000 additional acres being planted with treated seed.

Eight thousand nine hundred and fifty-four orchards were cared for wholly or in part according to recommendations of agents, including the following of suggestions on pruning and recommendations for spraying to control insect pests and fungus diseases.

LEGUME ACREAGE GREATLY INCREASED.—Considerable time was spent in helping to stimulate the raising of more legumes, both for forage, seed, and soil improvement, resulting in the sowing of 77,755 additional acres of alfalfa, 26,990 acres of sweet clover, 66,854 acres of soy beans, 8,798 acres of cowpeas, and 10,097 acres of vetch. A large number of demonstrations were conducted to show the importance of using lime, inoculation, and proper drainage, as well as following the best methods of seeding and harvesting legumes. In many counties where sweet clover and soy beans had been grown but little, if at all, farmers were encouraged to try a small acreage, with such satisfactory results that these crops will be grown much more extensively. Nearly 100,000 acres of clover and other legumes were plowed under for soil improvement.

SUCCULENT FEED PROVIDED.—Realizing the importance of conserving succulent feed, especially for dairy cows, the county agents in several States carried on definite campaigns to encourage farmers to build silos, which resulted in 7,245 silos being erected at their suggestion or as recommended. Silo-building campaigns were carried on most intensively by the county agents in Indiana, Wisconsin, Iowa, and Pennsylvania. The reports indicate that nearly a third of a million acres of silage corn were grown last year at the suggestion of county agents in the Northern and Western States.

MORE AND BETTER LIVE STOCK.—The production of more and better live stock with less expensive feed and greater profit to the producers has received considerable attention in nearly all counties. During 1917 the agents assisted in the organization of 160 live-stock breeders' associations to encourage the use of better sires, and 182 cow-testing associations to eliminate unprofitable cows and bring about more economical feeding. Through these associations and those organized with the assistance of agents in previous years 127,835 cows were under test, resulting in at least 8,724 cows being discarded as unprofitable. Primarily through these organizations 10,986 farmers were induced to adopt balanced rations for their herds, and the following number of head of registered stock were secured at suggestion of agents: Bulls, 3,285; cows, 4,836; rams, 1,469; and boars, 2,974. The agent also brought about the transfer to other herds of 3,370 valuable registered sires by means of information given to individual farmers or through exchange lists published by the farm bureaus.

In order to increase the production of live stock to meet the war needs, farmers were encouraged by personal conferences, at meetings, and through circular letters and newspaper articles to raise more live stock, resulting in more than 40,000 additional head of cattle, more than 100,000 additional hogs, and 148,211 sheep being raised or placed on farms. In some States a special effort was made to save calves from being slaughtered for veal, resulting in 10,499 additional calves being raised. This work was carried on most extensively in Wisconsin, from which 2,459 head of calves from high-grade or reg-

istered stock were shipped for breeding stock to Missouri, Wyoming, and other Western and Southern States, due to this campaign.

CONTROL OF LIVE-STOCK DISEASES.—The control of live-stock diseases was considered fully as important as growing more live stock, and the agents were instrumental in having 36,392 animals, principally cows, tested for tuberculosis; 197,508 animals were vaccinated for blackleg, and 235,866 hogs were vaccinated for cholera by farmers or veterinarians at the suggestion of agents, or by agents, for the purpose of demonstrating methods.

IRRIGATION AND DRAINAGE.—Eleven hundred and eighty-eight drainage systems, involving the drainage of more than a third of a million acres of land, and 225 irrigation systems, involving the irrigation of 162,475 acres of land, were adopted by farmers as planned by the agents. In many instances the principal work of the agents has been to arrange for the laying out of drainage districts and to show the farmers whose land would be benefited, the total cost per acre, and the returns which might be expected.

LIME AND FERTILIZERS.—The economical use of such commercial fertilizers as were available was advocated, and 6,662 farmers are known to have reinforced manure with acid phosphate or ground-rock phosphate; 17,333 farmers used chemical fertilizers and 2,680 farmers used home-mixed chemical fertilizers at the suggestion of or as recommended by agents. The agents tested soil for acidity on 11,163 farms, brought about the development of 301 local sources of marl or other forms of lime, and helped to have 64 limestone crushers introduced. These and other activities of the agents to encourage farmers to use lime to overcome soil acidity resulted in 186,873 additional tons of lime being used. In many instances where farmers could not grow alfalfa or clover successfully the application of 1 or 2 tons of lime per acre has overcome the soil acidity and resulted in a good stand, thereby increasing the yield of hay more than 100 per cent and even 200 per cent.

FOOD CONSERVATION STIMULATED.—Well-organized campaigns were carried on in several States to conserve food by canning and preserving, and the county agents arranged for 7,631 canning demonstrations for women, aside from club work, resulting in more than 4,500,000 additional quarts of fruit and vegetables being canned. Assistance in home gardening was given to 160,163 persons, while 82,434 farmers were given information in regard to the best methods of storing fruit and vegetables.

BUSINESS SIDE OF FARMING RECEIVED ATTENTION.—The business side of farming was not neglected; 12,841 farmers were induced to keep farm accounts, and farm analysis records were taken by the agents on 3,049 farms. Using these records and their accounts as a basis, 3,167 farmers modified their plans of management. Through the 637 farmers' exchanges and other cooperative purchasing and marketing associations organized with the assistance of agents or at their suggestion, more than \$18,000,000 worth of farm products and farm supplies were handled, resulting in saving nearly \$1,500,000 for the farmers.

NUMBER OF FARMERS REACHED.—In doing the above work the county agents personally visited 157,683 different farmers, gave informa-

tion to 468,514 callers at their offices, and took part in 55,432 meetings attended by more than 3,000,000 persons. More than three-fourths of a million letters were written giving information. They also sent out more than 3,000,000 circulars and circular letters. Specialists from the State colleges of agriculture or the United States Department of Agriculture took part in 14,545 of these meetings arranged for by agents.

BOYS' AND GIRLS' CLUB WORK.

The boys' and girls' club work continued under the direction of O. H. Benson. During the year ending June 30, 1918, 30 of the 33 Northern and Western States cooperated directly with this office in junior extension, or boys' and girls' club work. One State cooperated in the expenditure of Smith-Lever and war emergency funds, while the two other States cooperated to the extent of sending in reports of the work, using follow-up literature, and in other ways.

As a war-time measure additional effort was put forth to make boys and girls enrolled in club work a direct asset to the Nation in food production and food conservation. The special lines of work pursued included gardening, canning, drying; the raising of poultry, pigs, baby beeves, and sheep; the baking of liberty bread; the making and remodeling of garments for home use and for the Red Cross war work; and the making of homemade sirups from sugar beets, apples, and other fruits. Demonstrations were also carried on in the conservation of sugars, flours, meats, and fats.

Special enlistment cards were issued by the department and the State agricultural colleges cooperating, as an appeal to boys and girls for their help in the war program. Enrollment entitled the member to a card carrying the attractive 4-H club insignia in colors, and a certification of membership in the Boys' and Girls' Liberty Food Club. By June, 1918, a total enrollment of 614,531 members was secured. This number did not include many thousands who had not at that time signed and sent in regular enlistment cards, nor the large number of boys and girls in the cities engaged in war-garden production. The enrollment as above noted shows a growth over the regular 1917 enrollment of 39.4 per cent.

The special efforts in food production and food conservation gave results in the different lines of work, as follows:

(1) Home gardening, in which 68,234 members reported December 1, 1917, the production of \$893.521 worth of fresh vegetables.

(2) Home canning, in which 21,736 members reported 1,569,229 quarts of fresh vegetables, meats, and soups canned; 216,501 jars of jellies, jams, and preserves put up; and 2,740 pounds of fruits and vegetables dried.

(3) Poultry raising, in which 4,376 members reported 29,541 fowls managed, 106,358 chicks hatched, and 35,370 dozen eggs produced.

(4) Pig raising, in which 7,382 members reported 10,583 animals managed, producing 1,797,196 pounds of pork.

(5) Bread making, in which 5,242 members reported 346,698 loaves of liberty bread baked.

(6) Garment making, in which 13,165 members reported 92,189 garments and pieces of work for home use and for distribution to the Red Cross work.

These achievements in increasing the food supply were materially aided through efficient organization and leadership.

There are 1,664 counties in the 33 Northern and Western States, and of these 1,162 counties, or 69 per cent of the entire number, had regularly organized club work on December 1, 1917. Of these counties 555 were organized and conducted club work on the farm-bureau plan, while a total of 575 county farm bureaus supported club work financially. The work was supervised and directed by 1,018 paid club leaders, including 28 State, 115 assistant State, and 477 district county, and assistant county leaders on full time, together with 5 assistant State, 393 district, county, and assistant county leaders on part time. The local community interest in the work is shown by the fact that the 22,267 club groups organized had 15,983 volunteer local leaders to assist in the work. There were 348 training conferences held to help club leaders in the direction and supervision of their work. There were 38,847 club plats visited by leaders; 4,813 canning demonstrations, and 2,316 field demonstrations were given; 1,781 local, county, district, and State club exhibits conducted, and 864 club fairs and festivals held. There were 1,691,367 copies of club literature furnished by the department to club members, and about an equal number of copies were furnished by the States.

The following is a brief summary of financial returns from the club work at the close of the year 1917:

Total value of products produced by members reporting-----	\$3, 681, 329. 00
Total production cost to all members reporting (including labor of members at 10 cents per hour)---	1, 288, 675. 00
Total cost of supervision, all sources (Federal, State, and local)-----	329, 935. 00
Average cost of supervision for 12 months per member enrolled-----	. 75
Average cost of supervision for 12 months per club member reporting results-----	2. 00
Average value of products per member reporting---	22. 00

During the fiscal year ended June 30, 1918, the department demonstration and training kitchen of the boys' and girls' section was the center of important training and demonstration activities. Seventy-three State, assistant State, county, and local leaders were trained in the kitchen on methods of conducting extension demonstrations in canning, drying, garment making, bread making, poultry, potato, and corn. Four hundred and eighty-six complete demonstrations were given during the fiscal year. Twenty-seven regular training conferences with leaders were held. The training conferences ranged from three to six days each in duration.

The demonstration kitchen was also used for the following activities:

(1) The preparation of club exhibits to be loaned to the State leaders for their special State, district, and interstate events.

(2) A four days' training school was also conducted by the club section staff for the home demonstrators of the section of extension work with women in preparing them for field demonstrations and organization work in canning and drying.

(3) The preparation, in cooperation with the Office of Exhibits of the department, of an exhibit of 600 quarts of canned food products.

(4) As a room for the explanation of methods of canning, drying, equipment, devices, etc., used in extension activities with boys and girls, to visitors

to the department who wish to know about these matters. There was an average of five visitors per day during the year.

(5) For 30 days during the year the demonstration kitchen was used by the Red Cross committee of the department in the conservation of products from Arlington Farm. These canned and preserved products were sent directly from the kitchen to the Walter Reed Army Hospital.

FARM-MANAGEMENT DEMONSTRATIONS.

The primary purpose of farm-management demonstrations is to teach farmers business methods in organizing and administering their farm business. This work has been led in the different States by one or more extension specialists, called farm-management demonstrators. This demonstration service helps farmers to make their farms more efficient in the production of food by means of accurate analysis of the business of individual farmers and comparison with that of more efficient farmers in the neighborhood. The farmers are thus stimulated to greater production of food per acre, per animal, and what is more important, per man.

Up to June 30, 1918, farm-management demonstrations have been conducted in 493 counties, in 27 States—an increase of 210 counties within the year. The farm-management demonstration service has come in touch with more than 30,000 farmers who started simple farm accounts during the year. More than 2,500 of these have kept records for one year or more. The farm-management demonstration service account books have been in demand also to serve as a basis for the farmer in working out his income tax.

EXTENSION WORK WITH WOMEN.

The extension work with women in the North and West, Miss Florence E. Ward in charge, had a rapid growth during the year. At the end of June, 1917, 150 State-wide home-economics workers were employed and 17 home-demonstration agents were permanently located in counties in 10 States. These were employed chiefly on Smith-Lever and regular department funds. The passage of the food-production act in August, 1917, as a war measure, and the imperative necessity for producing and conserving foods and certain household commodities required by the war program resulted in increasing the number of home-economics workers employed on Smith-Lever, regular, and emergency funds to more than 1,000 women by the close of the fiscal year June 30, 1918. Of this number 811 were engaged in home-demonstration-agent work, 96 of whom were employed in cities and 361 in single counties as home-demonstration agents.

EMERGENCY PROGRAM.—For the first six months the principal work conducted under the direction of these workers was the conservation of surplus food products. This work was carried on in every State by means of demonstrations, exhibits at fairs and in local stores, food shows, and liberty bread kitchens where war breads were made and sold. The method of instruction by which the message of conservation was taken to the people in many States included the training of volunteer workers. This plan of procedure has proved one of the most valuable features in home-demonstration work. In one State an extension force of three home-economics workers gave instruction in food conservation to 2,200 local leaders. These local leaders reached 33,000 women during the canning season, and as a result 8,250,000 quarts of fresh products were canned.

ORGANIZATION.—The organization of county and city units was carried on in the majority of States simultaneously with that of the conservation of food, and the placing of a home-demonstration agent on the farm-bureau staff on a coordinate basis with the county agricultural agent and club leader has marked an advance in home economics extension work.

RESULTS.—Among the outstanding results obtained from the production and conservation activities may be mentioned the increased number and quality of home gardens; the increased number of home poultry flocks; the establishment of community drying and canning kitchens; a vast quantity of food preserved by canning, drying, and storing; a stimulation of the demand and use for milk and milk products. The home-demonstration agents have taken an important part in the special food campaigns of the past year, such as stimulation of the consumption of potatoes, cottage cheese, and home-grown products.

An unforeseen by-product of home-demonstration activities has been the Americanization work carried on by agents in sections populated by people of foreign birth or extraction. In many instances it was the home-demonstration agent in her food-conservation work who gave the foreign women the first understanding of the war and their duty as American citizens.

EXTENSION SPECIALISTS.

The work of specialists employed by the State agricultural colleges was supplemented during the year by that of specialists representing various bureaus of the department, cooperating with the Office of Extension Work North and West. The department specialists assisted in placing in the States cooperative instructors of extension and demonstrators on both regular and emergency funds. They extended their study of extension methods now practiced in the States and were in a way the means of transmitting the best methods from State to State. In some instances a closer correlation of the subject matter plans for extension work within a State was brought to the attention of extension workers.

These specialists carry to the States the results of the research work of the various bureaus of the Department of Agriculture, and through the State extension specialists the information is conveyed to county agents and to other local extension representatives, and thus made known to people on the farm and in the home. A further value in the work of the specialists through their intimate contact with the work in the field is found in the fact that they learn of the problems of the farmers, and are thus able to bring to the research bureaus of the department information of value in planning the work.

The following bureaus, offices, and divisions cooperated very closely with both regular and emergency funds:

The Forest Service stimulated a wood-fuel campaign as a means of increasing the supply of fuel wood, and to provide an opportunity for the application of approved forestry principles in selecting trees for cutting, and in selecting gunstock and airplane timber for the War Department.

The Bureau of Animal Industry through its specialists, entered actively into a campaign during October and November for increased

pork production. The organizing of pig clubs and sheep clubs wherever feasible was stimulated; encouragement was given to the introduction of sheep into a few of the Central States, into the cut-over pine lands of the upper lake region, and to the further adoption of sheep raising on New York and New England farms; attention was given to the production of beef cattle by economical methods in a few of the central Western States; poultry production for the increase of the egg and meat supply with special reference to a wheatless ration was urged in States not conducting poultry extension work. The dairy extension specialists conducted a very extensive cottage-cheese production and consumption campaign; in addition to the regular extension activities, namely, cow-testing associations, bull associations, dairy manufacturing, and farm dairy extension work. The specialist in charge of hog-cholera work engaged in extension work for the prevention of hog cholera by educational methods in many swine producing States, by arranging with the State extension service for the use of regulatory men, a part of whose time could be given to lectures and demonstrations on sanitation and instructions to county agents on methods of control.

The Bureau of Plant Industry used both regular and emergency funds to improve the seed stock of potatoes and beans through disease prevention and hill and plant selection. It also entered upon a campaign for the control of cereal smuts, by means of traveling squads of demonstrators in seed treatment. A campaign to eradicate the common barberry to prevent rust on wheat was well under way before the close of the fiscal year. One person gave attention to the methods of extension teaching practiced by State extension specialists in horticulture working on Smith-Lever projects, and to preparing material for boys' and girls' gardening clubs; and one was employed to enter upon a spring and summer campaign for home gardens. About 75 assistant county agents were employed as home garden demonstration agents. Specialists in the preservation of vegetables were employed cooperatively in two New England States.

The Bureau of Entomology employed a specialist to conduct its emergency extension work in the control of insect pests and in the increased production of honey. The assignment of extension entomologists to cooperating States proved very satisfactory and contributed greatly toward the State specialist becoming an active member of the State extension force. Short honey-production campaigns of a few weeks were conducted in the principal honey-producing States. A successful campaign for the control of the Coulee cricket was carried on in Oregon and Washington. In the Middle West an extensive campaign for control of the chinch bug was carried on, and a grasshopper campaign was conducted in Montana.

The extension specialist representing the Bureau of Soils has visited most of the Northern and Western States east of the Rocky Mountains. Three points were emphasized in his conferences: An increase in the nitrogen and humus supply by planning for some legume in the crop rotation and shortening the rotation; the addition of humus, also, by the better saving of manures, and using green crops and other crop residues; and an increased growth of nitrogenous crops to lessen feed bills and to increase the supply and improve the quality of manure.

The specialist representing the Bureau of Markets gave particular attention to securing outlets for the large quantity of Michigan potatoes on hand the 1st of February. The results of visits to other States was to direct attention to the marketing of particular products and to the formation of marketing organizations.

The Bureau of Biological Survey conducted extension work in practically all of the States west of the one hundredth meridian on the eradication of rodent pests, the most successful being in Montana and North Dakota. An extension specialist visited most of the 11 Western and Pacific States to further develop the plans of organization and method of control before the crop season came on.

The Office of Farm Management is cooperating through a section of farm-management demonstrations within this office. Its extension work has been directly as well as indirectly connected with the emergency problems of the war period, represented in record keeping, cost accounting, production per man, and labor distribution.

OFFICE OF HOME ECONOMICS.

C. F. LANGWORTHY, *Chief.*

ARTHUR D. HOLMES, *Assistant Chief.*

The work of the past year was influenced in a large measure by the war situation, particularly by the demand for reliable suggestions for utilizing the available food supply in a rational and economical way and one which at the same time provides a diet conforming so far as possible to general dietary preferences. The emphasis being placed on personal and family thrift as a patriotic duty also made it necessary to consider questions of conservation in the use of clothing, household supplies, and household equipment. Meanwhile the regular as well as the experimental and research work of the office was carried on as usual with such adaptations as made it contribute directly to the war emergency situation. For example, a comparative study of the digestibility and food value of breads made from the coarser flours in comparison with those made from the standard flour was taken up as an emergency measure, but fitted into the series of digestibility studies which for several years has constituted part of the regular work of the office.

A dietary survey was carried on, in cooperation with the Bureau of Markets, to supply exact information regarding the use which is being made of foods in the home. In this survey the results are worked up in groups as they accumulate, so that the information obtained may be available for immediate use. Data already accumulated have proved of decided value in discussing the broader aspects of the war emergency food situation. Upward of 1,000 records have been obtained from American homes and about 500 from boarding houses, college clubs, homes for children or adults, and other similar homes where groups are fed. The hearty voluntary cooperation of housekeepers and institutions in this work has been particularly gratifying.

A special series of food leaflets, brief and concise in form and non-technical in character, was prepared in cooperation with the United States Food Administration. These leaflets give reasons why certain foods should be used, rational and practical ways, including recipes, of preparing them for the table, and suggestions for their combina-

tion into palatable meals. The plan for the food leaflets was drawn up at a conference of agricultural extension workers. They have been very generally welcomed and have proved very useful in extension work of the department and other similar movements and have been used in homes and in nearly all lines of food conservation work. A million copies of each of these leaflets were distributed by the department. They are as follows: Nos. 1, Start the Day Right with a Good Breakfast; 2, Do You Know Corn Meal? 3, A Whole Dinner in One Dish; 4, Choose Your Food Wisely; 5, Make a Little Meat Go a Long Way; 6, Do You Know Oatmeal? 7, Food for Your Children; 8, Instead of Meat; 9, Vegetables for Winter; 10, Plenty of Potatoes; 11, Save Sugar; 12, Dried Peas and Beans; 13, Let the Fireless Cooker Help You Cook; 14, Save Fuel; 15, Milk—The Best Food We Have; 16, Fresh Vegetables—Good to Eat and Good for Your Health; 17, Use More Fish; 18, Rice; 19, Hominy; and 20, Wheatless Breads and Cakes.

The emergency publications of this office further include four special circulars urging the use of peanut flour, barley, soy-bean flour, and potatoes, besides a bread card giving general directions for using wheat substitutes in baking. Though the editions have been large, the demand for this popular literature has exceeded the supply. Much attention was given to the preparation of articles for the department's information service, more than 150 such articles having been prepared or edited during the year.

Studies on the utilization of foods continued to supply data relative to their digestibility and nutritive value. Experiments were made to determine the digestibility of dasheens; oils of the almond, black walnut, Brazil nut, butternut, English walnut, and pecan; various animal fats and oils, some of which are at present little used as separated fats, such as goat's butter, hard-palate fat, kid fat, oleo oil, oleo stearin, ox-marrow fat, oxtail fat, and turtle fat; corn, soy-bean, sunflower, Japanese-mustard, rapeseed, and charlock oils; soy-bean and peanut flours (ground press cake remaining after the extraction of oil from soy beans and peanuts); wheat bran, water-ground buckwheat, and black-hull kafir; and Boston mackerel, butterfish, grayfish, salmon (the studies of marine food materials having been made at the request of and in cooperation with the Bureau of Fisheries). Bulletins reporting the results of these experiments were published or manuscripts prepared. A special study on the digestibility of whole-wheat and graham breads in comparison with war emergency standard flour was made in addition to a study on the digestibility and nutritive value of bread, etc. In connection with the study of bread made from different sorts of cereal grains, cooperative work on barley was arranged with the Iowa Agricultural Experiment Station.

The work with the respiration calorimeter included a series of experiments on the energy expended in carrying on different household tasks, including sewing, washing, ironing, scrubbing, etc., the results showing a considerable range in energy expenditure and giving much-needed data for discussing problems of household work, particularly in connection with time studies which have been made previously in rural homes to ascertain the time which housekeepers devote to different household tasks. Attention was also given in the respiration calorimeter laboratory to studies of problems concerned

with the wintering of bees. This work was undertaken in cooperation with the Bureau of Entomology.

To furnish reliable data on which to base the recipes and practical suggestions published by the office, a laboratory kitchen was installed. Here methods of using food substitutes are tested, standard recipes are worked out, and much-needed information gathered regarding the chemistry and physics of cooking processes. In part of this work the Food Administration has cooperated. A demonstration kitchen has also been equipped in cooperation with the offices of extension work, which will afford opportunity for demonstrating to field agents the results of the department's experimental work and give them an opportunity to practice the different phases of extension teaching in home economics before undertaking the work in the field.

In addition to the cooperation with the Bureau of Chemistry (in problems relating to canning, drying, and salt-pickling foods, and the use of such products in the home), Bureau of Plant Industry, Bureau of Markets, Bureau of Entomology, and the War Department, the year has been characterized by cooperation with the Food Administration and with the Woman's Committee of the Council of National Defense, a member of the office staff having been especially appointed to serve with that committee as executive chairman of its department of food production and home economics.

The office cooperated with the Food Administration and the Bureau of Education in the preparation of four courses of instruction on food in the war emergency situation, designed particularly for women students in colleges and universities. Each course has included 13 lessons. In addition, a book entitled "Food Guide for War Service at Home" has been prepared for publication, which summarizes some of the more important subject matter of the lessons. The office also cooperated with the Food Administration and the Woman's Committee of the Council of National Defense in the preparation of a pamphlet entitled "The Day's Food in War and Peace," which includes 9 lessons on food topics. It is designed for the use of women's clubs and other organizations, each lesson including a discussion of the subject matter, suggestions for a demonstration with recipes for the use of the materials discussed, references to Government publications and to lantern slides prepared by the Department of Agriculture and the Food Administration.

The work with clothing, household textiles, and household equipment was continued, particularly with reference to the preparation of bulletins and other material on methods of handling and caring for such products in such a way that the period of usefulness may be prolonged. This work, as a whole, has a direct connection with war-emergency thrift problems, and a large amount of material has been brought together.

Correspondence with housekeepers, extension workers, teachers, and students markedly increased. This feature of the work is of great importance, not only for the opportunity it offers to aid housekeepers in some of their special problems, but also because of the useful and varied information which they furnish to the office.

REPORT OF THE DIRECTOR OF THE BUREAU OF PUBLIC ROADS.

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF PUBLIC ROADS,
Washington, D. C., October 14, 1918.

SIR: I have the honor to submit herewith the Report of the Office of Public Roads and Rural Engineering¹ for the fiscal year ended June 30, 1918.

Respectfully,

L. W. PAGE, *Director.*

Hon. D. F. HOUSTON,
Secretary of Agriculture.

WAR WORK.

At the time the United States entered the war there were on the rolls of the Office of Public Roads and Rural Engineering 187 male employees. Of this number 52, or 28 per cent, entered the military service between that time and the close of the fiscal year 1918. It may be added that the number of those entering the military service from June 30 to September 30, inclusive, has brought the total to 72, or 35 per cent of the male employees who were in the Office on April 6, 1917.

Engineers to the number of 18 have been assigned to Army posts and cantonments for the purpose of supervising and inspecting highway construction, involving several hundred miles of roads of varying types from sand-clay to concrete; at Quantico, Va., for the Marine corps, and at Gunpowder, Md., for the Edgewood Arsenal of the Bureau of Ordnance.

An engineer was assigned on March 5, 1918, to aid the United States Shipping Board Housing Corporation in working out highway and street problems in connection with the various housing projects. This arrangement continued throughout the remainder of the fiscal year.

A similar arrangement was made with the United States Housing Corporation of the Department of Labor. The engineer assigned to that duty did not begin active cooperation, however, until July, 1918.

¹ In the act making appropriations for the Department of Agriculture for the fiscal year ending June 30, 1919, the title of the Office of Public Roads and Rural Engineering is changed to Bureau of Public Roads.

The engineer of tests of this office devoted a considerable portion of his time to aiding the Emergency Fleet Corporation in the testing of materials for and the designing of concrete ships. This cooperation began in November, 1917, and extended throughout the fiscal year.

The testing laboratory of the office was engaged to a considerable extent in the design of apparatus for the Ordnance Bureau to test the power of various explosives. Other special work of this character was done from time to time, and the services of our mechanician, in addition to those of the testing engineers, were utilized to a considerable extent.

Complete and detailed highway maps were made, utilizing, as far as practicable, topographic sheets of the United States Geological Survey, covering all of Maryland east of the meridian passing through Washington, all of the coast counties of New Jersey, all of the coast counties of Connecticut, and all of Florida south of Jacksonville. In addition to these detailed highway maps, the principal highways in a zone extending from Boston to Newport News, through New York and Washington, were plotted on topographic sheets for the use of the Geological Survey. Detailed route maps were prepared, covering the route from Detroit to Baltimore.

The cooperation of the office was sought by the Capital Issues Committee in connection with highway, irrigation, and drainage bonds which were subject to the approval of the Capital Issues Committee. During the fiscal year, inspections were made of 126 highway projects involving bond issues aggregating \$49,276,366, and reports made to the Capital Issues Committee. Inspections were made of 25 irrigation projects, involving \$18,279,060, and 30 drainage projects, involving \$19,356,970, or a grand total of 181 inspections, involving \$86,912,396.

Early in the spring of 1918 it became apparent that unless positive action was taken, serious difficulty might arise in obtaining the necessary bituminous materials for highway work during the season of 1918. Accordingly, an arrangement was entered into with the Fuel Administration whereby that organization would issue permits for bituminous materials for highway work upon recommendation of the Office of Public Boards and Rural Engineering. Under that arrangement several thousand applications for approval of highway projects were submitted to the office and permits were issued by the Fuel Administration in line with the arrangement for amounts of bituminous materials equivalent to upward of 100,000,000 gallons. This work, however, was merged in June, 1918, into the work of the United States Highways Council, and the totals to June 30, inclusive, cover in addition to results obtained under the original arrangement, those obtained under the operation of the United States Highways Council for the period from June 8 to June 30, inclusive. To the close of the fiscal year, a total of 2,235 applications had been received, calling for the equivalent of 75,000,000 gallons of bituminous materials, of which 58,000,000 gallons had been approved and permits issued.

It became apparent early in the fiscal year that some method of coordinating the various powers of the Government with reference to highways was essential, not only to the appropriate regulation of

highway work during the period of the war, but to enable really essential highway work to proceed. Evidence of this existed in the fact that the Capital Issues Committee passed upon highway bond issues; the Railroad Administration controlled cars which were required in the transportation of highway materials; the War Industries Board had power to control essential highway materials, such as steel, cement, brick, crushed stone, etc.; the Fuel Administration exercised control over bituminous materials, such as oil, asphalt, and tars; the Department of Agriculture exercised the direct powers of the Government with reference to highways under the terms of the Federal aid road act, and the appropriations for the Office of Public Roads and Rural Engineering; the War Department was directly interested in highways which serve military purposes, such as Army truck routes, etc. Any highway project which required several of the facilities controlled by these various Government agencies was compelled, therefore, to be subjected to the delay and hazard of securing approval separately from each Government organization.

As an outcome of careful consideration, the Secretary of Agriculture requested the Secretary of War, the Director General of Railroads, the chairman of the War Industries Board, and the fuel administrator each to name a representative to serve with the Director of the Office of Public Roads on a council to coordinate these activities. In accordance with the Secretary's suggestion, the United States Highways Council was formed and held its first session on June 8, 1918. An immense amount of regulatory work has been done by the council since its organization.

The Director and the Chief of Management of the Office of Public Roads and Rural Engineering served respectively as chairman and secretary of the council. The office provided engineering and clerical assistance to the council as well as office room, necessary stationery, and printing. Engineers of the office made inspections of projects on which the council desired information.

FEDERAL AID ROAD ACT.

Notwithstanding the adverse conditions incident to the war, work under the Federal aid road act progressed well during the fiscal year. Efforts were made, in cooperation with the several State highway departments, to restrict construction work to such projects as would prove of greatest importance, serve the greatest economic or military use, and contribute, either directly or indirectly, to the success of the Government's war program.

During the fiscal year the legislative assent required by section 1 of the Federal aid road act was given by the legislatures of all States for which such assent had not already been given, except the State of Alabama. The Alabama legislature meets only quadrennially, and its next regular session will convene in January, 1919. It is expected that at that time the necessary legislative assent will be given for that State. However, the governor of Alabama assented on behalf of the State, as authorized by the act, so that cooperation with the State has not been affected adversely.

With a view to meeting unusual conditions that arose it was found desirable to amend the rules and regulations which were issued Sep-

tember 1, 1916, for carrying out the provisions of the act. During the fiscal year five such amendments were made.

During the fiscal year proposed standard plans, specifications, proposal notice, contract, and bond forms submitted by the highway departments of 34 States were reviewed. Where changes in the forms submitted were thought desirable, suggestions for such changes were made to the respective State highway departments. In addition, proposed form of specifications, notice to contractors, contract, and bond were prepared jointly by the Office of Public Roads and Rural Engineering and the Forest Service, and reviewed by the Solicitor of the department, for use in connection with forest road construction work under section 8 of the Federal aid road act.

With a view to greater uniformity in the forms of specifications, notice to contractors, contract, and bond used by the several State highway departments, a proposed standard form was prepared and suggested by the Office of Public Roads and Rural Engineering for general adoption by the States, subject to such modifications as might be necessary to adapt them to the statutes and particular requirements of the respective States.

During the fiscal year questions arose (1) as to what constitutes expenditures within the meaning of the Federal aid road act and (2) as to whether work on Federal aid post-road projects could be commenced prior to the beginning of a fiscal year upon projects approved prior to that date for payment out of such fiscal year's apportionment.

As to the first question, it was determined that when a project agreement is entered into between the Secretary of Agriculture and a State highway department such agreement constitutes an expenditure of the Federal funds thereby set aside and allotted to the project.

Regarding the second question, it was determined that a project statement might be submitted and approved and the project agreement therefor entered into prior to the beginning of the fiscal year out of the apportionment for which Federal payments would be made, but that construction work could not commence prior to the beginning of the fiscal year.

Closely related to the above question was one concerning the distribution of balances that may occur in connection with projects, and the elimination of a specific fiscal-year designation from project statements and project agreements. Concerning the latter question, it was determined that any balances that may occur in connection with projects covered by project agreements will accrue to the funds available to the State for the fiscal year within which such balances occur. It was also determined that it was unnecessary to specify any particular fiscal year's apportionment from which the Federal funds allotted to a project should be payable, the purpose being to consider disbursements of the Federal funds in the aggregate instead of by fiscal years. The determination of these questions in the manner indicated greatly facilitated the administration of the act.

Project statements were submitted by all of the 48 States, and plans, specifications, and estimates were submitted by 46 States. At the end of the fiscal year construction work was in progress in 30 States, and such work had been completed and final payments made on 5 projects, having an aggregate mileage of 17,643, costing \$347,380.70, and on

which \$166,274.84 Federal aid was paid. The total amount of Federal aid paid out during the year for construction was \$425,445.85.

During the fiscal year a total of 563 project statements were passed upon by the department, of which 4 were disapproved and 559 approved. Project agreements were entered into during the fiscal year to cover 205 of the 559 project statements, and project agreements were also entered into to cover 13 projects for which the project statements were approved prior to the beginning of the fiscal year. In other words, during the fiscal year a total of 218 projects were entered into, involving a total estimated cost of \$14,239,939.15 and a total of \$5,658,458.42 Federal aid. The project statements approved during the fiscal year and not covered by project agreements involve a total estimated cost of \$28,038,831.23 and \$10,391,363.32 Federal aid. All projects for which the project statements were approved or the project agreements entered into, therefore, involve a total estimated cost of \$42,278,770.38, Federal aid in the amount of \$16,049,821.74, and a total road mileage of 6,249.3965.

Action on projects during the fiscal year is shown by States in the following table:

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Action on Federal-aid post-road projects during fiscal year ended June 30, 1918.

State.	Num-ber dis-approv-ed.	Num-ber ap-prov-ed.	Project statements.						Of all approved projects—		
			Approved during the fiscal year.						Total esti-mated cost.	Total Federal aid involved.	Total road mile-age in-volved.
			Not covered by project agreements.			Covered by project agreements.					
			Num-ber.	Estimated cost.	Federal aid requested.	Num-ber.	Estimated cost.	Federal aid allowed.			
Alabama.....	1	26	3	\$67,575.99	\$32,469.48	23	\$529,007.68	\$263,507.11	\$596,583.67	\$295,976.59	174.295
Arizona.....		2	2	128,700.00	64,350.00				252,523.63	126,219.89	155.56
Arkansas.....		18	2	144,453.21	47,471.83	16	396,956.98	170,505.15	541,410.19	217,976.98	86.4032
California.....		4	3	952,653.79	439,821.89	1	210,668.48	105,334.24	1,163,322.27	545,156.13	89.79
Colorado.....		8	4	319,587.51	159,793.75	4	239,681.19	119,840.59	559,268.70	279,634.34	160.51
Connecticut.....		21							148,694.04	53,000.00	5.3
Delaware.....		2	2	918,599.00	33,000.00				918,599.00	33,000.00	17.8
Florida.....		4	2	163,974.74	82,037.36	2	103,761.81	37,041.64	267,736.55	119,079.00	17.8
Georgia.....		14	13	735,849.85	344,891.89	1	37,728.90	18,864.45	773,578.75	363,756.34	3201.84
Idaho.....		46	1	243,988.80	86,000.00	4	457,588.34	185,000.00	701,577.14	271,000.00	99.36
Illinois.....		3	3	2,532,711.42	1,193,685.77				2,532,711.42	1,193,685.77	151.95
Indiana.....		7	7	797,430.00	302,300.00				797,430.00	302,300.00	30.23
Iowa.....		16	9	569,872.60	201,887.40	7	635,611.25	161,627.90	1,205,483.85	363,515.30	276.95
Kansas.....		9	3	588,112.76	393,670.22	2	339,006.47	139,351.47	2,588,112.76	393,670.22	131.475
Kentucky.....		5	3	187,291.24	93,647.12	2	339,006.47	139,351.47	526,300.71	232,998.59	44.625
Louisiana.....		7	1	50,286.12	20,000.00	6	531,079.96	199,688.06	581,366.08	219,688.06	95.61
Maine.....		1	1	246,268.23	123,134.11				528,935.14	264,467.57	28.45
Maryland.....		2	2			2	98,233.10	43,300.00	282,666.91	141,333.46	6.34
Massachusetts.....		8	6	287,264.80	115,060.00	6	245,128.93	109,248.38	342,308.12	17,154.06	6.34
Michigan.....		19	13	767,808.09	361,754.92	6	824,584.90	389,284.83	532,393.73	224,308.38	23.941
Minnesota.....		23	14	875,573.14	353,205.40	9	472,881.96	175,742.18	1,669,982.45	789,834.48	161.725
Mississippi.....		26	22	599,024.02	245,390.87	4	205,703.27	90,000.00	340,137.75	158,109.00	572.105
Missouri.....		6	4	222,739.83	72,932.65	2	160,725.40	40,181.35	804,727.29	335,390.87	242.21
Montana.....		7	7	127,555.12	63,777.56				383,465.23	113,113.40	59.23
Nebraska.....		10	4	207,941.93	103,970.96	6	546,040.37	205,792.74	127,555.12	63,777.56	60.25
Nevada.....		8	4	504,556.93	252,278.47				753,982.30	309,763.70	341.97
New Hampshire.....		15	8	140,340.69	70,670.35	7	106,574.20	53,287.07	504,556.93	252,278.47	92.3
New Jersey.....		1				7	106,574.20	53,287.07	16,341.14	8,170.57	24.10
New Mexico.....		12	1	698,944.88	349,469.94	3	257,341.26	59,212.68	293,256.03	132,127.99	24.10
New York.....		8	2	202,800.00	101,400.00	6	209,348.56	104,674.27	257,341.26	59,212.68	9.694
North Carolina.....		18	8	219,845.77	75,500.00	6	513,374.11	256,687.05	908,293.44	454,144.21	236.32
North Dakota.....		23	15	258,435.57	129,217.77	10	355,569.90	112,500.00	716,174.11	358,087.05	41.35
Ohio.....		17	10	2,019,587.64	507,605.30	8	162,235.77	81,117.88	26,392.83	13,196.41	179.282
						7	1,229,580.28	382,073.00	420,671.34	210,335.65	324.81
									3,249,167.92	889,678.30	98.75

	4	375,131.55	147,229.37	1	394,643.70	180,000.00				375,131.55	147,229.37	130.0923
Oklahoma.....	4	567,171.24	240,585.61	1	394,643.70	180,000.00				961,814.94	420,585.61	98.52
Oregon.....	7	2,527,360.00	822,200.00	8	1,286,464.80	358,930.00				3,812,824.80	1,131,130.00	118.113
Pennsylvania.....	13	40,918.35	11,500.00							126,362.51	46,497.13	4.79
Rhode Island.....	1	237,232.15	99,165.33	3	85,595.08	40,836.66				322,827.23	140,001.99	30.57
South Carolina.....	6	249,621.17	114,805.19							249,621.17	114,805.19	60.27
South Dakota.....	7									275,267.64	134,129.29	28.40
Tennessee.....	4			4	275,267.64	134,129.29				3,993,884.06	1,703,230.35	940.282
Texas.....	68	3,641,171.27	1,562,834.21	6	352,712.79	140,405.14				447,651.85	223,825.91	237.49
Utah.....	7	3,316,519.75	158,259.86	1	131,132.10	65,566.05				131,678.45	65,839.21	12.705
Vermont.....	6	70,378.17	35,189.08	4	61,300.28	30,630.13				403,018.91	187,344.32	131.376
Virginia.....	9	156,371.26	74,276.93	6	218,206.43	98,846.78				831,476.41	389,723.82	168.86
Washington.....	10	373,386.50	177,500.00	6	396,359.46	181,358.60				802,033.36	202,651.71	56.99
West Virginia.....	4	620,046.88	148,060.23	5	181,986.48	54,891.48				1,481,412.65	493,804.17	195.343
Wisconsin.....	20	975,050.66	325,016.81	14	506,361.99	168,737.36				365,618.23	182,809.10	6143.27
Wyoming.....	43	108,692.61	54,346.29	4	256,925.62	128,462.81						
Wyoming.....	15											
Total.....	559	28,038,831.23	10,391,363.32	205	13,014,369.44	5,086,726.34	13	1,225,569.71	571,732.08	42,278,770.38	16,049,821.74	6,249.3965

1 Includes large bridge.

2 Later withdrawn.

3 Includes 6 large bridges.

4 1 later withdrawn.

5 Includes 4 bridges.

NATIONAL FOREST ROADS.

During the fiscal year ending June 30, 1918, the survey and construction of National Forest roads progressed satisfactorily considering the unfavorable conditions which depleted the engineering organization and seriously affected the supply of labor, construction materials, and cooperator's funds.

Previous to the beginning of the fiscal year the present field organization had been installed. It was further developed during the year as the work required, with a view to providing an efficient road engineering and construction organization immediately available for conducting the road and bridge work called for by the Forest Service. Either a district engineer's office or suboffice was established in each of the six places in which the western district foresters' headquarters are located in order that a district engineer or his assistant might be immediately available in each forest district.

Work under way at the beginning of the fiscal year was continued to the end of the working season as far as practicable. At the beginning of the calendar year 1918 an annual working plan covering the entire calendar year was prepared in cooperation with the Forest Service. Care was taken to limit work to those roads which would contribute to the winning of the war or which could be built without drawing upon the supplies of labor, material, or transportation required for war industries. As the season advanced unfavorable conditions made it necessary to eliminate further projects from consideration until after the war.

The following tabulation shows the number of projects and the aggregate mileage covered by investigations and surveys of Forest roads during the fiscal year:

Surveys of National Forest roads.

Type of survey.	Number of projects.	Total miles.
Preliminary investigations.....	62	1,524.5
Reconnaissance surveys.....	47	911.75
Location surveys and plans.....	41	797.5
Total.....	150	3,233.75

Construction was under way on approximately 53.5 miles of road distributed over projects as follows:

Construction under way on National Forest roads.

Project.	Miles.	Estimated cost of project.	Project.	Miles.	Estimated cost of project.
Middle Elk, Oreg.....	2.5	\$8,500	Monument-Nursery, Colo.....	0.5	743
Alberton, Mont.....	4	64,000	Deadwood-Hot Springs, S. Dak.....	1	4,656
Trinity River, Cal.....	5	40,000	Cass Lake Bridge, Minn.....	.3	21,000
Laguna Road, Cal.....	14	38,552			
Salmon River, Cal.....	18	165,000	Total, 10 projects.....	53.5	366,411
Winslow-Long Valley, Ariz..	4.2	20,975			
Alpine, Colo.....	4	2,985			

ROAD BUILDING AND MAINTENANCE INVESTIGATION.

Object-lesson roads were built of sand-clay construction at Tarboro, N. C.; top-soil construction in Henry County, Va.; and gravel construction at Austin, Tex.

The superintendence of the construction of county roads was conducted in Sussex and Albermarle Counties, Va.

The following-named State highway departments were assisted in various lines of their work: Arkansas, Kentucky, Louisiana, North Carolina, Texas, Virginia, and West Virginia.

Reports on county road systems were made for Potter and Wheeler Counties in Texas, and Fresno and Merced Counties in California.

Advice was given in regard to special road problems in Alabama, Arizona, Arkansas, California, Louisiana, Minnesota, Oklahoma, South Carolina, South Dakota, Texas, and Wisconsin.

Investigations in regard to bond issues were made to comply with the request of the Capital Issues Committee in Jackson County, Ark., Cook and Madison Counties, Ill., and Oakland County, Mich.

The superintendence of the construction of an experimental post road in Dubuque County, Iowa, was completed.

Engineers were furnished to plan for and superintend the construction of the roads in 16 National Army cantonments: at Quantico, Va., in connection with the Marine Corps, and at Gunpowder, Md., in connection with the establishment of the Edgewood Arsenal for the Bureau of Ordnance of the War Department.

One engineer was assigned to assist the Emergency Fleet Corporation in planning for and building the streets in the villages being constructed by that corporation.

Designs for bridges were prepared as follows: California, 4; Florida, 1; Idaho, 1; Minnesota, 1; North Carolina, 1; South Carolina, 2; Virginia, 2. Engineers were assigned to investigate existing bridges and conditions in relation to proposed bridges in Kentucky and Virginia. General designs and specifications which had been prepared by several State highway departments and local officials were examined and reviewed.

FIELD EXPERIMENTS.

The section of roadway in the Department of Agriculture grounds between Twelfth Street and Thirteenth Street was constructed as a bituminous macadam road, using quartzite as the mineral aggregate. The experimental top-soil road, which was constructed in Prince William County, Va., during the previous year, was maintained, and approximately 30 miles of experimental roads which had been constructed during previous years in Alexandria and Fairfax Counties, Va., and in Montgomery County, Md., were maintained.

ROAD MANAGEMENT AND ECONOMICS.

The economic highway survey, inaugurated toward the end of the preceding fiscal year, was continued. The complete maps and text give detailed information on the roads, bridges, and economic conditions in the territory covered by the surveys. The work has proved of greater value than was at first anticipated, as it brings together in a

workable manner considerable detailed highway information. This work has not only been of value to the State highway departments and this office, but is proving of value to other branches of the Government. Copies of the completed maps are supplied to the Post Office Department, Geological Survey, and the War Department. In certain localities additional data have also been collected and indicated on the maps.

During the year field surveys have been made in cooperation with the State highway departments covering that portion of Maryland east of the meridian, through Washington, or about two-thirds of the entire State; the coastal portion, or 37.4 per cent of the State of New Jersey; the coastal portion or 39.3 per cent of the State of Connecticut; the coastal portion or 65 per cent of the State of Florida; and in addition an area in the vicinity of Camp Lee, near Petersburg, Va.

A set of instructions has been compiled in order that the work of a similar character may be carried out in the various States independent of the assistance from the Government.

ECONOMIC STUDIES OF STATE HIGHWAY SYSTEMS.

In an endeavor to segregate the information which might prove useful in the further development of highway management a very thorough investigation was completed during the year as to the organization, personnel, powers, and duties of State and local highway forces. The study also included the classification of highways and a study of the procedure followed in their construction and maintenance. The method of raising and handling funds for road purposes has been prominently placed in the study.

The results of this study are being published in installments in Public Roads under the caption State Highway Management Control and Procedure.

GENERAL ECONOMIC AND STATISTICAL WORK.

Current data were collected and published in regard to State highway mileage and expenditures and to automobile registrations and the disposition of these revenues. It was found that during the calendar year 1917 the cash expenditures on our rural roads and bridges amounted to a grand total of \$279,915,332. Of this total \$98,179,332, consisting of \$47,290,790 State and \$50,888,542 local funds, was expended under the supervision and control of the several State highway departments.

It was also found that a total of 4,983,340 motor cars, including commercial vehicles, and 257,522 motor cycles were registered in the 48 States and the District of Columbia. The sum of \$37,501,237 was collected in registration and license fees, including those of chauffeurs, operators, and dealers. Of these fees about 67 per cent, or \$23,235,898, was expended more or less directly under the control and supervision of the several State highway departments. As the entire amount of State funds devoted to rural road and bridge work was \$47,290,790, those derived from the registration and licensing of motor vehicles, chauffeurs, operators, and dealers formed about 49 per cent of the total.

ADDRESSES, LECTURES, AND PAPERS.

Technical advice has been rendered during the year on legislation, organization, management, construction, and maintenance. This work has been carried on through conferences, lectures, and the presentation of papers. Efforts were made during the year to limit this work to meetings and conferences of official bodies of sufficient State or nation-wide importance to justify the attendance of department representatives. Practically all propaganda work has been discontinued during the period of the war.

A total of 149 lectures was delivered, as compared with 263 during 1917 and 655 in 1916. The total attendance at such meetings was 19,561, as compared with 43,184 in 1917 and 92,610 in 1916.

MODELS AND EXHIBITS.

Practical demonstrations by means of models and other exhibit materials were made during the year to illustrate the various activities of the office. This exhibit material was built and maintained by the office, but all expenses of transportation and installation were paid by the organizations benefited. All exhibit work was carried on in cooperation with the Office of Exhibits of the Department. Exhibits were made at nine places during the year as follows: State Fair, Hutchinson, Kans., September, 1917; International Wheat Show, Wichita, Kans., October 1 to 13; National Farm and Live Stock Show, New Orleans, La., November 10 to 19; Massachusetts Institute of Technology, February to October; New York Electrical Exposition, October 10 to 20; Rochester (New York) Industrial Exposition, September; International Exposition, Cleveland, Ohio, September 1 to 9; State Fair, Dallas, Tex., October 13 to 28; Albemarle Highway Association and Chamber of Commerce, Charlottesville, Va., November.

PHOTOGRAPHIC WORK.

The photographic laboratory developed 1,630 negatives, made 6,276 prints, 649 lantern slides, 177 bromide enlargements, and 555 photostat prints. In addition to this work 1,332 lantern slides were colored for lecture work and 5,235 maps were mounted on cloth. For the benefit of various individuals and organizations, including employees of the office, 1,913 lantern slides, 5,203 prints, and 425 bromide enlargements were loaned. At the close of the year the photographic files contained 19,728 negatives, 51,332 prints, and 12,640 lantern slides.

ROAD MATERIAL TESTS AND RESEARCH.

Research work, as compared with the preceding fiscal year, fell off materially. This was due to loss of employees and inability to replace them with experienced men; also to the fact that cooperation with other branches of the Government in war activities and supervision of material specifications and tests for Federal aid activities consumed much time. Considerable assistance was given to the Fuel Administration in connection with its activities on the United States Highways Council. This work has to do with recommendations relative to granting permits for securing bituminous materials for road

construction and maintenance. Beginning May 13 the Fuel Administration refused to issue permits for the use of such materials in highway work unless applications were first made to the Director of the Office of Public Roads and Rural Engineering and the work approved as an urgent necessity.

The work of the Conference of State Highway Testing Engineers and Chemists, held during the fiscal year 1917, was supplemented by the preparation of two bulletins, both of which have been published. In general, the recommendations of the conference were followed, with a view to standardizing specification requirements of all types of road materials.

Twelve hundred and ninety-eight samples were analyzed in the laboratories during the fiscal year. The decrease of approximately 4 per cent as compared with the preceding year is considered very slight in view of present conditions.

ROUTINE CHEMICAL TESTING AND INSPECTION.

Two hundred and eighty-nine samples were examined in the chemical laboratory. This represents a total decrease of something over 3 per cent as compared with the preceding fiscal year. It is expected, however, that a marked increase will be shown for 1919, owing to check tests which will be made on samples of materials used on Federal aid projects. Of the samples examined 255 were bituminous materials, 12 metal, and 22 sand, soil, and miscellaneous materials.

PHYSICAL TESTS OF ROAD BUILDING MATERIAL.

The physical laboratory tested 1,009 samples, an increase of nearly 10 per cent. as compared with the preceding fiscal year and well above the average annual routine testing. Of these samples, 571 were rock and slag, 117 gravel, 206 sand, clay, soil, etc., 90 cement and concrete, 8 brick, 5 oil, and 12 miscellaneous. Samples were received from all but 12 States of the Union. States from which the largest number of samples were received are as follows:

Maryland.....	200	Texas.....	24
Virginia.....	154	District of Columbia.....	22
Massachusetts.....	114	Alabama.....	20
Pennsylvania.....	89	Louisiana.....	15
New York.....	67	Vermont.....	14
Ohio.....	53	Arkansas.....	14
North Carolina.....	50	Maine.....	11
Connecticut.....	44	Missouri.....	10
New Jersey.....	43	New Hampshire.....	10
South Carolina.....	26		

The results of physical tests of road-building rock in 1916 and 1917 were published as Department Bulletin 670.

MICROSCOPIC EXAMINATION AND CLASSIFICATION OF ROAD-BUILDING ROCK.

The microscopic laboratory examined and classified 630 samples of road-building materials, a decrease of a little less than 7 per cent. as compared with the preceding fiscal year, but well above the average routine work. Of these samples, 322 were rock and slag, and 308 gravel, sand, clay, etc.

RESEARCH ON DUST PREVENTIVES AND ROAD BINDERS.

As a result of research and experimental work as well as observation of the work of highway engineers throughout the country a set of typical specifications for bituminous materials for various types of roads and methods of use was prepared and sent to all manufacturers who were thought to be interested, with the request that they review the specifications and suggest changes if they thought desirable, giving their reasons for such changes. Upon receipt of all the information that could be secured, these specifications were redrafted and published as Department Bulletin 691, under the title, "Typical Specifications for Bituminous Road Materials." This bulletin contains 30 specifications for petroleum, asphalt, and tar products, with descriptions of the general methods of use for which the materials are suitable, methods of testing the materials for conformity with the specifications, and directions for sampling.

An investigation of the relation of the consistency of road oils at normal temperature to the so-called asphalt content test has been completed.

The following subjects are under investigation: The effect of variations in refining methods upon the characteristics of road oils and asphalt produced from crude petroleum; the thickness of bituminous films upon different types of mineral aggregates; the physical properties of coarse bituminous aggregates; the effect of colloids on bituminous materials.

EXPERIMENTAL BITUMINOUS ROAD CONSTRUCTION AND MAINTENANCE.

As in 1917, supervision and inspection of experimental bituminous roads has been largely confined to the vicinity of Washington, although inspections of experimental surface treatments of gravel roads were made in Texas and inspections of asphalt earth roads were made in Missouri, Pennsylvania, New Jersey, and Connecticut.

In all of the experimental work of the year, which included the maintenance of roads constructed in previous years, this division cooperated with the engineering division. A total of 40 inspections was made.

NONBITUMINOUS ROAD MATERIAL INVESTIGATIONS.

During the year an exhaustive investigation of commercial quarry practice in the production of crushed stone for road-building purposes was begun. A special study was made of such practices in the New England and Middle Atlantic States. A progress report of these investigations was published under the title, "The Commercial Sizes of Broken Stone Aggregate," in the June number of Public Roads. A report was also prepared on small scale production of crushed stone for public roads, dealing in an elementary manner with the selection of quarry sites and the installation and operation of suitable equipment. It is felt that such information is of great value in furthering the use of local materials, which is particularly desirable under present war conditions. A paper upon "Saving Fuel in Highway Work" was also published in the May number of Public Roads.

As a result of investigations a set of typical specifications for non-bituminous road materials was prepared for publication as a department bulletin. This bulletin, in general, conforms to the recommendations of the first conference of State Highway Testing Engineers and Chemists, and it is believed will do much toward furthering standardization of specifications for such materials. Forty individual specifications are given, covering brick, gravel, mineral filler, Portland cement, sand, sand-clay, slag, stone, stone block, top soil, and total mineral aggregate for various types of road. Each specification is followed by a brief description of the suitability of the material for a given purpose. The bulletin also contains methods for testing the materials for conformity to the specifications and directions for sampling.

The survey of quarry conditions in the United States has been continued in the Middle West and South. About 170 quarries have so far been studied.

The following subjects are under investigation: The suitability of various types of soil for the construction of bituminous soil roads; the standardization of screening practice in the production of crushed stone; and the use of slag in road construction.

STANDARDIZATION OF METHODS OF TESTING BITUMINOUS ROAD MATERIALS.

Cooperative work with the American Society for Testing Materials was continued, and as a result a number of standard methods and definitions were recommended to the society for adoption. Improvements were made upon an apparatus originally devised by the office for accurately determining the consistency at normal temperature of road oils and tars used in the surface treatments of macadam and gravel roads. Cooperative work will be continued with the American Society for Testing Materials in connection with a number of standard tests and specifications.

STANDARDIZATION OF METHODS OF TESTING NONBITUMINOUS ROAD MATERIALS.

As a result of cooperation with Committee D-4 of the American Society for Testing Materials, various standard tests, methods, and definitions were recommended to the society for adoption. Investigations have been continued and are now in progress upon the following subjects: Revision of the standard abrasion test for rock, the standardization of an abrasion test for gravel, the development of new tests for paving brick and concrete.

CONCRETE INVESTIGATIONS.

Concrete investigations during the past year have been mainly confined to cooperation with the United States Shipping Board in determining the resistance to shear of various structural members used in concrete ship designs; also in the protection of reinforcement from the action of sea water with reference to disturbing as little as possible the bond between reinforcement and concrete. A number of inspections were made of concrete construction.

Investigations are being continued upon reinforced concrete slabs, wear measurements of experimental concrete roads, and the pressure developed against concrete forms under various heads at different stages of pouring concrete.

ROAD AND BRIDGE FOUNDATION TESTS.

Investigations have been continued upon pressures resulting from hydraulic fills. This work was conducted in cooperation with the Miami conservancy district, and the results of investigations have been worked into such shapes as to be of considerable value to engineers. Field tests with apparatus devised in the office have also been made on earth fills in the vicinity of Washington. A paper upon "Tests to Determine Pressure Due to Hydraulic Fills" was published in the April number of Engineering News.

It is planned to conduct investigations relative to pressure distribution through soils serving as subgrade for various types of pavements. Information along this line is urgently needed by highway engineers owing to the increasingly heavy loads which roads are now being called upon to carry.

FARM-IRRIGATION INVESTIGATIONS.

The Division of Farm Irrigation continued its established lines of work with some curtailment on account of war necessities and the loss of employees to the military service. While maintaining the continuity of studies already in progress, effort has been made to render these of immediate practical value, especially where increased food production might be encouraged thereby. Thus, by the publication of practical bulletins, by correspondence, and by the personal efforts of employees in the field, improved methods of utilizing water in irrigation have been effected and the farmers in irrigated sections have been induced to put forth greater efforts on account of the assistance given.

For the double purpose of effecting economy in administration and of bringing the activities of the division into immediate touch with the western country, its headquarters were transferred during the spring of 1918 from Washington, D. C., to Berkeley, Cal. The wisdom of this move was demonstrated promptly, as many appeals for advice and assistance from farmers and communities were met, which could have received only belated attention at best under the former arrangements. The design and installation of small reservoirs and pumping plants, and the preparation of land for irrigation in response to calls, especially from more or less isolated communities, were much facilitated by this change of headquarters.

Although advancing prices and cost of equipment and shortage of labor have cut down materially the extension of pumping for irrigation from underground sources in many localities of the West, it has been possible to maintain some degree of this extension by the demonstration of cheaper methods of well-sinking and pumping in sections where established methods had been based on local practice without reference to methods developed with better success in similar conditions elsewhere. Notably on the Great Plains, this

campaign has met with much success, with prospect of material benefit in the near future to lands heretofore farmed with indifferent results by dry-farm methods.

A serious condition of wide extent had appeared in this section. An area 600 miles in extent north and south and over 400 miles broad in western Texas and southern New Mexico had been in the grip of an unprecedented drought for more than two years, which brought great hardship to the farmers, reduced crops in some sections to the vanishing point, and threatened to ruin the previously thriving live stock industry of that region. Relief from the drought has been sought in the development of underground sources of water, and it is believed, from results already attained, that a considerable extension of the irrigated area will be the outcome of the present activity along this line.

Strong efforts have been made to bring about the efficient drainage of lands which have been water-logged or seriously injured by the rise of alkali through faulty methods of irrigation, this activity taking form not only in surveys and the supervision of installation of drainage systems on individual farms, but in the urgent encouragement of the formation of irrigation districts under State laws; and organizations so formed within the year have included in their boundaries many thousands of acres, the fertility of which should show immediate improvement upon the installation of the drains.

A new line of work appeared in the investigations undertaken at the instance of the Capital Issues Committee of the Treasury Department into proposed bond issues by irrigation and drainage enterprises. It was necessary, of course, for the committee to take into account the engineering and agricultural feasibility of the projects, the latter being considered to depend upon the character of crops to be grown under the reclamation proposed and the promptness with which they could be brought to the country's markets. During the spring of 1918, 19 such projects were investigated, usually by employees upon the ground. Approval of bond issues totaling \$11,372,000 was advised, these involving the proposed reclamation of 255,800 acres.

Progress in the purely technical investigations of the division included the completion of an extended report on the flow of water in concrete pipes, the beginning of a study of the efficiency of siphon spillways for use in storage and canal systems, and the devising of a new type of meter for measuring flowing water.

DRAINAGE INVESTIGATIONS.

The wet areas in cultivated farm lands usually are the most fertile when the soil moisture is properly controlled, because generally they are depressions into which more or less of the richest soil from surrounding fields has been washed. Farm drainage transforms these unproductive places into highly productive land, thus increasing the profitable area and the average yield per acre, while at the same time removing obstacles that increase the time and effort required for farming operations. Recognizing the importance of this possible conservation of man power, the Drainage Division during the year has given first consideration to these projects looking to the improvement of lands already under some degree of cultivation or needing only drainage to prepare them for the plow.

The cooperative agreements of previous years covering extension work in Alabama, Georgia, and North Carolina, have been continued, and a new similar agreement with the University of Tennessee has been made, but by no means has the work been confined to those States.

Drainage surveys and plans have been prepared during the year for 226 farms in 18 States, comprising probably 12,000 acres. Field examinations and special recommendations were made for probably two dozen other farm owners.

Drainage surveys and plans have been made for Ottawa Lake Outlet Drain in Monroe County, Mich., 23,900 acres; for Meadow River in Greenbrier County, W. Va., 6,000 acres; and for Kettle Creek in Wilkes County, Ga., 1,150 acres. Preliminary investigations and reports were made for 20 other overflow districts, comprising approximately 215,500 acres.

A survey and plan of drainage were made for 5,100 acres in Zekiah Swamp in Charles County, Md. Inspections were made of six other swamp-land districts in the southeastern States, with general recommendations regarding the drainage of the 26,000 acres involved.

A preliminary investigation and report were made upon drainage for 1,100 acres of tide lands in New Jersey.

An important work has been performed for the Capital Issues Committee by investigating drainage districts that have requested the committee's approval of proposed bond issues. Twenty such requests have been referred to the office by the committee and have been investigated, affecting almost 7,000,000 acres and involving about \$14,700,000.

An investigation and report upon the situation with regard to drain tile available in the central and southern States was made.

Some research studies have been continued; to have discontinued such work entirely would have sacrificed considerable value. However, as more than half the drainage staff are in active military service, reports upon most of the investigations have been delayed, although the data for them have been collected.

Comprehensive studies have been made of the results secured from the drainage ditches that have been constructed in Oklahoma, North Carolina, and other States, with note of the features that affect the value of the works. Department Bulletin 652 was issued, "The Wet Lands of Southern Louisiana and Their Drainage," a revision of Department Bulletin 71. In cooperation with the Michigan Geological and Biological Survey, an examination has been begun to learn the amount of drainage undertaken in that State, its cost and results, and the legislation necessary to afford the most practicable means of reclaiming the land still needing drainage. A map has been prepared showing the drainage districts organized in Louisiana, and indicating the progress in developing those districts. Accurate data have been compiled relative to silting and erosion in natural and artificial waterways in many districts, bearing upon the problems of ditch maintenance.

Considerable data have been gathered in several central and southern States relative to rates of run-off that determine the economical

sizes of drainage ditches and drainage pumping plants, and the values of coefficients used in computing ditch capacities.

The field studies were made for a publication relating to assessments for drainage improvements, and the application of legal provisions to secure equitable distribution of the costs.

Profiles have been plotted, showing the compacting and subsidence of typical muck soils in Florida and southern Louisiana due to drainage and cultivation; this has an extremely important bearing upon the cost of reclamation, since such subsidence increases the height that the drainage water must be pumped or requires large ditches for the decreased fall available.

Investigations have been made of the value of special ditching plows for installing tile drains, and of "vertical" drains to discharge water into the subsoil. Some further experiments have been made to determine the capacities of tile drains, as well as upon flow through corrugated culvert pipe, and the loss of head due to silt wells in tile lines. Manuscript for a farmers' bulletin on "Terracing Farm Lands" has been prepared and submitted for publication.

Tests upon clay tile wrapped with wire and laid in concrete, for distributing mains in farm irrigation plants, have demonstrated that such material will serve the purpose excellently, withstanding considerable pressure and costing much less than iron or other suitable material generally procurable. The division has developed an automatic spray nozzle for overhead irrigation systems, and an automatic valve for sewage irrigation plants, which will be tested at once under field conditions; it is believed that these will reduce greatly the attendance necessary to secure uniform distribution of the water. Plans have been made for five farm irrigation systems in Southern States, and for four small sewage irrigation plants. Inspections and recommendations have been made regarding irrigation for several more farms. Data upon results of irrigation at Neenah, Wis., and upon small irrigation plants in the Middle Atlantic States have been compiled.

RURAL ENGINEERING.

FARM DOMESTIC WATER SUPPLY AND SEWAGE DISPOSAL.

Manuscript for a comprehensive bulletin entitled "Water Systems for Farm Homes," including 51 illustrations, was prepared in November, 1917. Work was also begun on a bulletin of like scope, dealing with the disposal of farm sewage. Field examinations and oral advice have been given on a half-dozen rural water and sewer projects. The essential features of several farm water and sewerage systems have been determined, and outline designs transmitted. A combined storm-water and sanitary sewer for a portion of the Arlington Experimental Farm has been designed.

FARM STRUCTURES.

Working drawings and bills of materials have been prepared for free distribution for the following: Sweet-potato storage houses, concrete root-storage house, general barn, feed barn, concrete farm sterilizer, calf barn, small bull barn, combined cornerib and granary, small portable granary, and a small well house.

Complete plans and specifications were prepared for the color investigations laboratory and the laboratory building for the Bureau of Public Roads, both at the Arlington Farm.

A number of farmstead layouts for individual farms have been made.

Manuscript for a bulletin on farmstead planning, including four typical layouts, has been completed, and is awaiting approval.

MECHANICAL PROBLEMS.

A compressed-air spraying outfit was designed, built, and tested out, by this Office.

A survey was made for a small hydro-electric plant near Vienna, Va.

A dust-spraying apparatus for use in dusting cotton plants for the eradication of the boll weevil was designed and public patents are being secured.

A hot-water heating layout was prepared for a farm home in Ohio. Accurate cost data are to be kept by the owner and furnished this office.

Farmers' Bulletins 946 and 947, on the Care and Repair of Plows and Harrows, and the Care and Repair of Mowers, Reapers, and Binders, have been published.

Manuscript for a Farmers' Bulletin on the care and repair of thrashing machines was prepared.

Short articles have been prepared for distribution on general directions for the installation of hydraulic rams; operation and wiring diagrams for electric bells; memorandum on the construction of ice houses, and iceless refrigerators. Small sketch plans have been made, in many instances, to accompany correspondence regarding proposed ice houses, and cold-storage rooms construction.

Problems relating to and correspondence in connection with the following subjects have been handled:

Hydro-electric installations.	Wall plasters and kalsomines.	Concrete.
Farm-house lighting systems.	Farm water supplies.	Fire proofing.
Farm-house heating plants.	Farm sewage disposal.	Chemical closets.
Ice-house design and construction.	Locating water supplies.	Farm implements.
Wind-mill electric outfits.	Small grain-grinding outfits.	Tractors and gas engines.
Power development of streams.	Self feeders for hogs.	Fence posts and fencing.
Refrigerating plants.	Grain-products manufacture.	Farm-machinery patents.
Cold storage on the farm.	Homemade farm implements.	Cost of fencing.
Farm structures of all kinds.	Stream measurement.	Thrashing machines.
	Paints and painting.	Stump pullers.
	Farmstead planning.	Rotary tillers.
		Protection against lightning.
		Cost of agricultural implements.

Information series for use in correspondence have been prepared during the year on the following subjects: Department of Agriculture publications pertaining to agricultural engineering; cement or concrete products machinery manufacturers; grain products manufacture, grain handling, storage, etc.; housing; storage structures, fruit and vegetables; poultry; castor oil; damp proofing, concrete walks, etc.; ventilation of farm structures; fence posts.

The Division of Rural Engineering has cooperated with several activities of the Government in connection with war work. The chief of the division has acted as a member of the committee appointed by the Secretary to handle the matter of farm-implement control. Considerable work has been done in connection with the standardization of farm implements in cooperation with the Conservation Division of the War Industries Board. Assistance has been rendered various activities of the War Department in connection with dynamometer tests and the industrial education of soldiers. Some assistance along this latter line has also been rendered members of the Vocational Education Board.

Specifications have been prepared for the Bureau of Entomology and the Bureau of Plant Industry for the rental and purchase of tractors and other implements. Assistance has also been rendered the mechanical shops in connection with shop and power problems.

REPORT OF THE SOLICITOR.

UNITED STATES DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SOLICITOR,
Washington, D. C., September 30, 1918.

SIR: I submit herewith report of the work of the Office of the Solicitor for the fiscal year ended June 30, 1918.

Respectfully,

WM. M. WILLIAMS, *Solicitor.*

Hon. D. F. HOUSTON,
Secretary of Agriculture.

SUMMARY.

As the various activities of the department relating directly to the war have increased during the fiscal year, so has the work of this office increased. We have been called upon to consider numerous new and novel questions growing out of the food production and food control acts, and the enforcement of the food and drugs act and regulations thereunder in conjunction with the food control act. Much time has been devoted to drafting or reporting on proposed legislation which related directly to the war, as well as on other legislation.

Under your direction, upon requests of committees or Members of Congress, the office has prepared or assisted in the preparation of a number of emergency measures, some of which have become law.

Assistance was given in the preparation of proclamations of the President to license the ammonia, fertilizer, and farm-equipment industries, and stockyard operators and others handling or dealing in live stock in connection with stockyards. This office prepared either in whole or in part the regulations of the President governing operations of licensees under the aforesaid proclamation, the regulations for the administration of the so-called food products inspection law, various legal forms in connection with the licenses required under the several proclamations, the schedules and orders for making the food surveys conducted under section 2 of the food production act, and forms of contracts, applications, and other papers in connection with the distribution of nitrate of soda under the food control act.

In connection with a bill for the voluntary mobilization of agricultural labor and for Government loans to farmers, the agricultural lien laws of 16 western and northwestern States were examined and

a report made thereon to the House Agricultural Committee, and assistance was given the Bureau of Markets in the preparation of tentative application forms, circulars of information, and the like for use in administering the loan provisions of the bill if it should be enacted.

Considerable time was given in assistance to about 200 military registrants in the preparation of their questionnaires.

Under your direction, upon requests of committees or Members of Congress, the office also prepared or assisted in the preparation of proposed legislation not directly related to the war. In addition numerous special items for inclusion in the regular and emergency appropriation bills for the department were drafted and comments and suggestions were made on 65 other bills which had been referred to this department. Besides the assistance rendered with reference to the regulations under war-emergency legislation, this office prepared either in whole or in part numerous other regulations and amendments of regulations for the administration of various statutes. Among these were amendments to and partially completed revision of the regulations for the administration of the grain standards act, and a revision of the standards for shelled corn and wheat; regulations for the administration of Federal bird reservations, regulations for the administration of the national forests, regulations for the administration of the Federal aid road act, regulations for the administration of the plant quarantine act, regulations to govern entry into the United States of tick-infested cattle under the act of August 10, 1917, regulations for the administration of the United States standard container act, and also legal forms for the administration of several acts of Congress not related directly to war activities. Among these were orders establishing, modifying, or removing animal quarantine, specifications of grades for white and sweet potatoes and other vegetables, and various forms required in the administration of the Federal aid road act, the warehouse act, and the standard container act.

In cooperation with the Federal Trade Commission and the Bureau of Markets an investigation of grain marketing practices in Chicago and Minneapolis was participated in. This investigation covered a period of approximately seven months. Public hearings on proposed cotton warehouse regulations were attended by representatives of this office in Washington and 13 southern cotton markets, and representatives of the office attended conferences in Atlanta and New York with bonding and insurance companies relative to the cotton warehouse regulations. Public hearings on corn and wheat standards in 15 grain markets throughout the United States were attended by representatives of this office, and various conferences, including one in New York City, between representatives of the Bureau of Markets and the Food Administration Grain Corporation, relating to grain matters in general, were attended.

The plan adopted during the last fiscal year, at the request of the Department of Justice, for the preparation by this office of the petitions for the condemnation of lands under the Weeks law has effected a substantial saving in time and expense to the Government.

Law work for the Forest Service during the year, other than under the Weeks forestry law, included the handling of the following cases and other business:

Law work for the Forest Service, except that under the Weeks forestry law.

Claims to lands.....	549	Trespasses:	
Hearings attended.....	44	Grazing	259
Depositions	11	Timber	32
Briefs prepared and filed..	45	Fire.....	108
Motions for rehearings....	29	Occupancy	60
Oral arguments.....	1	General litigation.....	71
		Written opinions.....	484
		Contracts and similar papers..	1,888

The following is a summary of the work of the office in connection with the acquisition of lands under the Weeks forestry law:

Work under the Weeks forestry law.

Character of work.	Tracts.	Acreage.
Purchases authorized by National Forest Reservation Commission	201	171,339.68
Agreements of purchase prepared.....	237	192,542.00
Titles in process of examination at beginning of year	56	131,977.00
Examinations of titles completed and reported to Department of Justice:		
Purchases recommended.....	126	103,762.00
Condemnations recommended.....	63	137,728.41
Titles approved by Justice Department in process of adjustment	11	42,126.00
Titles in process of examination at end of year.....	93	121,796.00
Completion of direct purchases after approval by Attorney General.....	111	62,561.44
Completion of purchases acquired by condemnation.....	143	109,378.24

Three meetings of the National Forest Reservation Commission were attended.

The following table shows the number of contracts and leases prepared or examined for sufficiency and proper execution for the various bureaus, divisions, and offices of the department:

Contracts and leases prepared or examined.

Bureau, division, or office.	Contracts.	Leases.
Bureau of Animal Industry.....	18	54
Biological Survey	3	.....
Bureau of Chemistry	10	10
Chief clerk	11	30
Bureau of Crop Estimates.....	2	9
Bureau of Entomology.....	7	48
Federal Horticultural Board.....	9	11
Forest Service.....	2,170	13
Insecticide and Fungicide Board.....	1	.....
Office of Markets.....	14	80
Bureau of Plant Industry.....	36	42
Office of Public Roads.....	233	8
Bureau of Soils.....	4	1
Supply Division.....	4	.....
Weather Bureau.....	21	42
Exhibits.....	.....	2
Farm Management.....	1	.....
States Relations.....	1	1
Solicitor's Office.....	.....	2
Total.....	2,545	353

During the fiscal year 31 bonds, 341 renewals, and 44 terminations were prepared.

Eleven hundred and fifty-two written opinions, including the 484 above mentioned for the Forest Service, were rendered. In addition 140 written opinions upon questions arising in the administration of the United States grain standards act were drafted, and 24 Service and Regulatory announcements and information bulletins of the Bureau of Markets, containing opinions and information relative to the act, were examined and changes suggested when necessary.

Forty-nine applications for letters patent on inventions of employees of the department for dedication to the public were prepared and filed. During the year 34 applications were allowed and 3 disallowed.

Project statements for 663 projects under the Federal aid road act were reviewed and 218 project agreements, under that act, with certificates of approval of plans, specifications and estimates, involving a total estimated expenditure of \$14,239,939.15, were examined. There were also examined 49 original and supplementary cooperative agreements under section 8 of the act relating to roads and trails in national forests.

Forty claims for balances due estates of employees of the department who died intestate were examined, the necessary papers prepared for their payment, and advice furnished administrative officers of the department relating to the same.

Nine cases involving irregularities or misconduct of employees in their official duties were reviewed, the necessary investigations made, and appropriate papers prepared. In addition advice was given on special features of several other personnel cases, no record of which was preserved in this office.

Aid was given the advisory committee on finance and business methods in drafting a revision of the administrative regulations various amendments of the fiscal regulations, and orders and memoranda of the Secretary for the general administration of the department, and to other bureaus and offices of the department in drafting regulations, amendments of regulations, and orders required in the administration of the acts of Congress administered by them.

Many documents of various kinds, including statements of issues, briefs, and memoranda on legal matters were prepared on behalf of the officials of this department for submission to the Attorney General, the Secretary of the Interior, the Comptroller of the Treasury, and the officials of other departments. Among the questions were whether section 5 of the pending bill to carry into effect the migratory bird treaty with Great Britain, so far as it provided for searches and seizures without warrant, would be constitutional; whether a department employee may be compelled to testify in behalf of a litigant upon matters coming to his knowledge through his official position; whether the department might accept a gift of lots in Colorado for use as headquarters of forest officers; whether the department might pay the cost of advertising required by the Colorado statutes as a condition precedent to the execution and delivery of a deed to the Government of certain lots of land; and whether the

statute providing for the sale of lands containing deposits of potassium applies to the national forests.

Hearings were conducted at Kansas City, Mo., to develop the facts in regard to certain charges preferred against three serum companies for violation of the regulations governing the preparation, shipment, and importation of viruses, serums, toxins, and analogous products intended for use in the treatment of domestic animals.

Violations of statutes intrusted to the department for enforcement, upon which reports were made and prosecutions recommended to the Attorney General, or upon which settlements were effected without litigation, and the amount of fines and recoveries in cases terminated and reported to this office during the year, were as follows:

Violations of statutes considered.

Law invoked.	Violations.	Fines and recoveries.
Laws for the protection of national forests.....	444	\$71,404.54
Food and drugs act.....	797	19,407.00
Twenty-eight hour law.....	1,168	64,925.00
Animal quarantine act.....	385	12,750.00
Meat inspection.....	29	758.25
Lacey Act.....	38	2,873.00
Bird reservation trespass law.....	27	45.00
Virus act.....	3	-----
Insecticide act.....	123	2,446.00
Plant quarantine act.....	11	95.00
Miscellaneous.....	59	300.00
Total.....	3,084	175,003.79

Under authority of section 4 of the food and drugs act, and section 4 of the insecticide act, 1,371 Notices of Judgment were prepared for publication. In addition, 325 decrees of condemnation and forfeiture were entered under the food and drugs act and 4 under the insecticide act.

Investigation was made in numerous other cases which were not reported to the Department of Justice for action because of the absence of proof of material facts or on account of other infirmities. Evidence submitted to the office by various bureaus of the department which disclosed apparent violations of the postal laws and regulations was referred to the Postmaster General for action.

Many memoranda on legal questions were furnished on cases reported to the Department of Justice for prosecution, and in some assistance was given in taking depositions and statements of witnesses, and in the trials. Among the important cases in which this office assisted, either in the preparation of briefs or in the trials, or both, were *United States v. Cleveland Macaroni Co.*, *United States v. Safe Investment Co. and Frank Steiskel* (on appeal); *United States v. Mt. Valley Water Co.*, *United States v. Bethesda Mineral Springs Co.*, *United States v. 200 cases of Tomato Catsup*, *United States v. Hall Texas Wonder*, *United States v. Kar-ru Chemical Co.*, *Ralph H. Cameron, et al., v. United States* (on appeal), *United States v. Elk Mountain Mercantile Co.*, *United States v. Carbon Timber Co.*, *United States v. Hartford & Eastern Railway Co.*, *United States v.*

Thomas Nolan, Bob Solen, and E. A. Matson, all unreported; *United States v. P. John Muller* (pending on demurrer), *Willimot Valley Lumbermen's Association v. Southern Pacific R. R. Co.* (pending decision), *United States v. Kern River Co.* (pending decision), *Grand Trunk Western Ry Co. v. United States*, 248 Fed. 905.

Tabulated statements, showing in detail the facts and status of the principal prosecutions originating in the department in which United States attorneys have commenced proceedings, and of the claims and other cases affecting the administration of the national forests in which this office is concerned, are retained in this office for reference.

The work of the office, considering its nature, was current at the end of the year.

In former reports of this office, reference has been made to daily conferences with officials and employees of the department on legal questions arising in their work, and very general statements were made with reference to letters and memoranda prepared by various bureaus and divisions of the department and submitted for examination and criticism. Realizing that a large portion of the time of this office had been and was being devoted to such conferences and examination and criticism of letters and memoranda, a plan was put into effect on August 1, 1917, whereby a record would be kept of these items of business, in order that it might be ascertained with some degree of accuracy how much time was being devoted to them during the remainder of the fiscal year. The result is a record of 2,230 hours, or the equivalent of 297 days, so devoted, and of 1,237 letters and memoranda so examined and criticized, exclusive of the conferences by the assistants in the field and the personal conferences of the Solicitor, of which no record was kept.

Somewhat detailed statements of the principal activities of the office, without unnecessary reiteration of what has been fairly covered by the foregoing summary, follow:

THE NATIONAL FORESTS.

LAND CLAIMS.

At the commencement of the fiscal year there were pending 411 cases. During the year 138 were added and 148 closed, leaving 401 cases pending at the close of the fiscal year. A total of 549 cases, involving about 110,337.104 acres of land claimed under the homestead, timber and stone, mineral, lieu, and railroad selection, and other general and special land laws of the United States, were handled during the year.

One hundred and eighty-two decisions were rendered, including those of registers and receivers and the Commissioner of the General Land Office, subject, respectively, to review by the commissioner and the Secretary of the Interior. The registers and receivers decided 42 for and 16 against the Government. The commissioner decided 58 for and 30 against the Government, and the Secretary decided 5 for and 31 against the Government. Of the 148 cases closed during the year, 59 were by decisions in favor of the Government, 54 by decisions against the Government, 11 by the proof being withdrawn or relin-

quishments filed after protest by the Forest Service, 17 by withdrawal of the protest, and 7 by eliminations from the forests. As a result of the 59 decisions in favor of the Government, approximately 12,177.141 acres of land, supporting a stand of approximately 91,427,325 feet of timber valued at approximately \$359,041, were retained in the National Forests.

The remaining 363 cases received attention varying in degree with their progress in the Forest Service and in the Department of the Interior.

Hearings were attended in 44 cases. Depositions were taken in 11 cases. Briefs were filed in 45 cases. Oral argument was made before the Secretary of the Interior in 1 case. Twenty-nine motions for rehearing were filed, 5 of which were accompanied by briefs, and 1 reply brief to a petition for supervisory authority was filed. Sixteen appeals to the Secretary of the Interior, supported by briefs in 7 cases, were prosecuted from adverse decisions of the commissioner.

The assistants to the Solicitor in the field examined and passed upon the evidence in many cases, in addition to the 138 new cases in which protests were prepared, to be filed in the local land offices by the district foresters, and either returned the papers for additional evidence or recommended that no objection be made to the issuance of patent.

FORESTRY LAND DECISIONS OF INTEREST.

[Departmental.]

In *ex parte Arthur Crowley* (D-34600—Contest 3188, Visalia), the Secretary of the Interior, on August 23, 1917, held that a mill-site location must be used for the purposes specified in the mining laws and can not be taken for summer residence purposes.

In *ex parte Santa Fe Pacific Railway Co.*, Isem M. Jackson, attorney in fact (D-41268—Phoenix 022775), the First Assistant Secretary of the Interior, on February 1, 1918, declined to recommend modification of Executive order of January 3, 1917, creating Public Water Reserve No. 42, Arizona No. 7. The railroad company on June 17, 1913, by its attorney in fact, had filed a forest lien selection for a tract of land within the reserve upon which a watering place known as the "Ed. Geddes Tank" had been constructed some 20 years prior thereto for watering stock grazing on the surrounding public land. This being the only watering place in the vicinity, and consequently of great importance to the stock-raising industry, it was considered necessary to retain Government control thereof with a view to preventing monopoly of the water or range in the vicinity. In order, however, that the rights of the owner of the watering place might be protected, it was suggested that application for a permit for the tank be filed under the act of February 15, 1901 (31 Stat., 790). The existence of the water reserve was held to preclude the approval of the lieu selection.

In *Pine Mountain Water Co.* (46 L. D., 240), it was held that the grant of a right of way made by section 4 of the act of February 1, 1905 (33 Stat., 628), for the construction and maintenance in national forests of dams, reservoirs, water conduits, water plants, etc., is not confined to municipal corporations, but may be obtained by citizens or private corporations for the purpose of furnishing water for municipal purposes, and that likewise an applicant may acquire a right of way for use in connection with the operation of mining or milling works not his own.

In *Bilitik Ichi v. Phelps* (46 L. D., 283), it was held that section 31 of the act of June 25, 1910 (36 Stat., 855, 863), providing for allotments to Indians in national forests, is not limited in its application to Indians occupying, living on, or having improvements on lands within national forests at the date of the act. This was in accordance with an understanding reached by the two de-

partments on February 23, 1917. It was also held in this case that the listing and opening to entry of lands under the provisions of the forest homestead act of June 11, 1906 (34 Stat., 233), do not preclude their being taken as Indian allotments under section 31 of the act of 1910.

TRESPASS.

Damages and fines recovered during the year for trespasses upon the national forests were:

Penalties for trespass on national forests.

Class of trespass.	Damages.	Fines.
Grazing.....	\$22, 198. 73	\$1, 861. 79
Timber.....	7, 827. 97	95. 00
Fire.....	1, 877. 87	¹ 1, 960. 10
Property.....		50. 00
Occupancy.....	34, 164. 03	25. 00
Miscellaneous fines and recoveries.....		1, 343. 05
Total.....	66, 068. 60	5, 335. 94

¹ This includes fines recovered by prosecution in the State courts under the State fire laws amounting to \$1,270, in addition to which jail sentences aggregating two years were imposed.

Fifty-seven cases of illegal occupancy were handled during the year, involving the unlawful use of land for various purposes. They were dealt with mainly by the institution of injunction proceedings or settlement without recourse to the courts. In 3 cases, referred to in the report for the preceding fiscal year, where the Supreme Court affirmed decrees of the lower court enjoining the use without permit of forest lands for the development of hydroelectric power, petitions for rehearing were denied and damages agreed upon and paid by the defendants amounting to \$33,854.37, included in the foregoing table. In a similar case the district court entered an order giving defendant 60 days in which to make payment in compliance with the demand of the Secretary of Agriculture, in lieu of which injunction would issue. In a suit in ejectment the jury rendered a verdict for the Government and the court reserved its decision on a motion by defendant to allow it to make showing of certain equitable defenses. In another ejectment suit judgment was entered for the Government. Injunctions were granted in favor of the Government in 7 cases. A decree canceling a patent was entered in 1 case, and in another a decree canceling an easement. The bill in 1 case was dismissed. The remainder were either settled voluntarily by defendants or were pending in various stages at the close of the year.

GENERAL LITIGATION.

Fifty-four cases not referable to any of the above classes were handled. Among these were 8 involving questions of water rights. One suit to cancel patent to a railroad selection on the ground that the list was filed subsequent to the forest withdrawal and 1 suit to restrain a timber operator from cutting on the selection are pending. There are also pending 2 suits against a timber operator and its sureties for the value of timber cut from homestead claims subsequently canceled. Two condemnation suits were handled, in one of

which the matter was settled by mutual agreement, and in the other a decree for the Government was granted. In 1 suit in the State court by a mining claimant to enjoin a special-use permittee of the Forest Service from making use of his permit intervention by the United States resulted in a decree by the State supreme court in favor of the defendant. Three suits to cancel patent were handled, in one of which a demurrer to the bill was sustained, with leave to amend, and in the other two the bills were dismissed. A suit instituted by a mining claimant to enjoin a forest supervisor from selling timber on his mining claim, although he had consented thereto, was settled by mutual agreement. An action against a forest supervisor, instituted by a packer under an alleged Government contract, is pending. Two actions on uncompleted timber-sale contracts resulted in judgments for the United States. Two suits to quiet title to public lands were handled, one of which resulted in a decree for the United States; the other was pending at the close of the year.

There were also pending 1 suit to restrain the unauthorized use of an easement, 1 to cancel an easement, 1 to collect charges under a stipulation, and 1 to enjoin the maintenance of an unlawful fence. In a suit instituted by a claimant to public land to enjoin Forest Service permittees from watering stock thereon a decree was rendered for the defendant. A suit to recover for the unlawful use of Government-owned hay was pending at the close of the year, as were also three proceedings before the State railroad commission and Interstate Commerce Commission to establish or regulate railroad rates. Another proceeding to regulate railroad rates resulted in the granting of the petition and the establishment of the rates as prayed for. A request upon the State of Idaho for the proceeds of Government lands rented by the State to individuals through error is pending action by the legislature.

CRIMINAL CASES.

Thirty-three criminal prosecutions were handled during the year. Of these 20 were prosecutions for violation of the law and the regulations of the department governing the Pisgah National Forest and Pisgah National Game Preserve, N. C. Four convictions were secured, one case was closed on the defendant absconding, and the remaining cases are pending. Two prosecutions under the State game laws are also pending. In an action for criminally libeling a forest officer the defendant was convicted in the State courts. A prosecution for removing an established section corner resulted in an acquittal. In prosecutions for illegally cutting Government-owned hay, for forgery, and for failure to register under the draft law defendants were convicted. A prosecution for conspiracy to collect money on a Government fire-fighter's check was dismissed.

There were pending at the close of the year 1 prosecution for larceny and 1 for bribery. There was also pending 1 prosecution for theft of Government property, and in a similar case the grand jury failed to indict. Also, a prosecution was pending against a forest officer on a technical charge of murder, for shooting a man while assisting a United States marshal in making an arrest.

FORESTRY COURT DECISIONS OF INTEREST.

In *United States v. Thomas Nolan, Bob Solen, and E. A. Matson* the defendants, who were indicted on October 31, 1917, were convicted and sentenced by the United States District Court for the Western District of Washington on December 31 to imprisonment for one year and a day in the Federal penitentiary at McNeil's Island for conspiracy to violate sections 49 and 52 of the Penal Code, which prohibit, respectively, cutting or wantonly destroying timber on the public lands of the United States and willfully setting fire to or leaving it unattended near such timber. The defendants, members of the I. W. W., on August 22, 1917, went to the camp of the Snow Creek Logging Co., purchasers of Government timber in the Snoqualmie National Forest, where a severe fire had broken out on July 14, and made such representations to the men who were fighting the fire that about one-half of them quit work and left the camp on the following morning, after which the fire continued burning several weeks and destroyed additional Government timber. The case has had a very beneficial effect.

In *United States v. Cameron et al.* the circuit court of appeals for the ninth circuit, in an opinion of May 6, 1918, affirmed the judgment of the United States District Court for Arizona enjoining the defendants from occupying or conducting any business upon or in any manner interfering with the administration or use by the Government of certain land within the Tusayan National Forest and Grand Canyon National Monument, formerly embraced in what was known as the Cape Horn lode-mining location, but which had been declared null and void by the Secretary of the Interior upon rejecting defendants' application for patent.

In *Cameron v. Bass* (168 Pac., 645) the Supreme Court of Arizona affirmed the action of the lower court in refusing to enjoin the defendant, a Forest Service permittee, from erecting certain buildings on land within the Tusayan National Forest and Grand Canyon National Monument claimed by the plaintiff under the Cape Horn lode-mining location above mentioned, which upon application for patent therefor had been declared null and void by the Secretary of the Interior. The court held that the Secretary of the Interior had jurisdiction to determine whether the land was mineral, and his decision that it was non-mineral is binding on the world and renders the location void ab initio in the absence of fraud, accident, imposition, or mistake.

In *Emigh v. Matthews et al.* the Idaho State court refused an injunction sought by the plaintiff, a squatter on Government land within the Minidoka National Forest, to restrain the defendants, who held grazing permits from the Forest Service, from watering sheep at a spring within the squatter location, the decision being based upon the fact that the squatter location was invalid because it was not made until after the land had been withdrawn for the national forest.

In *United States v. Hammond Lumber Co.* the United States District Court for Oregon, on October 29, 1917, held that a school section (sec. 36, T. 9 S., R. 5 E.) within the Santiam National Forest was unsurveyed, notwithstanding that the south and east township lines had been surveyed and the quarter-section corners established, and that since the interior survey of the township had not been made prior to the forest withdrawal the defendant did not acquire any title to the land by conveyance from the State.

In *United States v. Thomas E. Marks*, involving the unlawful occupancy of land within the Snoqualmie National Forest, the United States Court for the Western District of Washington, on November 27, instructed the jury that the defendant, a settler prior to the creation of the forest, had no right to the land after service of the decision of the Secretary of the Interior denying motion for rehearing of a decision holding the squatter location invalid.

In *United States v. Frank C. Hunter*, trustee in bankruptcy for the Elk Mountain Mercantile Co., a suit to enjoin disposition of the company's assets until the Government should establish priority for a claim of \$22,076.46, for which judgment was recovered December 21, 1916, on account of a fire trespass on the Medicine Bow National Forest, the court, on September 14, 1917, dismissed the Government's bill, holding that since the claim of the United States had not been liquidated on the date (Jan. 13, 1916) of the adjudication in bankruptcy the Government was not entitled to priority of payment. Priority, except as to claims for labor performed within three months which are preferred under the bankruptcy act, was claimed under section 3466 of the Revised Statutes, which provides that in case of insolvency debts due the

United States shall be satisfied first. The court held, however, that the Government was not suing in its sovereign capacity, but as a proprietor or owner of land which had been damaged by the negligence of the company, and that consequently it must be treated as any other litigant and was subject to the provisions of the bankruptcy act in the presentation, allowance, and liquidation of its claim. Therefore, since its claim was not reduced to judgment until 11 months after the adjudication in bankruptcy, it was not entitled to priority. Hence the Government would merely be entitled as a general creditor to a pro rata distribution of the assets of the company after the allowance of preferred claims.

In *United States v. Carbon Timber Co.*, R. D. Meyer and Andrew Olsen, trustees, the United States District Court for Wyoming, on June 19, 1918, held that the United States was entitled to priority and directed the trustees to pay its claim of \$4,507.70, together with interest from the date of judgment. The Carbon Timber Co., on September 15, 1915, being then insolvent, had made an assignment of its property to the trustees above named for the benefit of its creditors, and the Government, on December 21, 1916, recovered judgment in the amount stated against the company on account of a timber trespass on the Hayden National Forest. The company being insolvent at the time of the assignment, the court held that the Government was entitled to priority under sections 3466, 3467, and 3468 of the Revised Statutes, and that the American Surety Co., having paid as surety the amounts due the Government by reason of the default of the Carbon Timber Co. on certain contracts in connection with which bonds were given, was entitled to the same rights as the United States. The judgment, together with interest and costs, was paid into the registry of the court on or about June 25.

In *United States v. Hartford & Eastern Railway Co. and Northern Pacific Railway Co.*, involving the reasonableness of rates on logs as affecting the Snoqualmie National Forest, the public service commission of the State of Washington, on January 2, 1918, in response to the petition of the Forest Service, directed the defendants to establish rates on logs of \$1.60 to Everett and \$1.75 to Kirkland. The rates quoted and against which complaint was filed were \$2.40 and \$3.20, respectively.

In *United States v. Edward B. Franklin*, an interlocutory decree was granted by the Federal Court for the District of Arizona restraining the defendant from interfering with the public use of the waters of Wolf Hole Lake. The court reserved jurisdiction for final decree until the Land Department passes on the defendant's homestead application for the land upon which the lake is located.

In *Exploration Co. v. United States* (247 U. S. —), it was held that the act March 3, 1891 (26 Stat., 1093), limiting to six years the time within which suit may be brought to vacate and annul patents for public lands, does not begin to run in the case of fraud that has been concealed or was committed in such a manner as to conceal itself until it is discovered by the Government.

IMPORTANT FORESTRY DECISIONS OF THE COMPTROLLER.

In *Frank C. Clark's case*, it was held on January 17, 1918, that a temporary laborer employed at the rate of \$100 a month, with the understanding that he was to furnish a horse to assist in packing supplies, could be reimbursed for the loss of the horse under the act of March 4, 1913 (37 Stat., 843), in view of the implied contract of hire, which might be inferred from the understanding that he was to furnish the horse, and that the rate of compensation was greater than would have been paid for the owner's services alone.

In *Raleigh R. Bryan's case* (24 Comp. Dec. 358), it was held on December 18, 1917, that a statutory forest officer furnishing a horse for the use of the Government, under the provisions of a regulation (Reg. A-4) by which the Government agrees to furnish a part of the feed in return for the use of the horse, may be reimbursed under the provisions of the act of March 4, 1913 (37 Stat., 843), for the loss of the horse while used on official business, since a contract of hire arises upon the furnishing of a horse in response to the offer made by the regulation.

IMPORTANT FORESTRY OPINION OF THE ATTORNEY GENERAL.

In an opinion of May 27, 1918, with reference to the case of *United States v. Charles Curtis*, involving an alleged fire trespass on the Idaho National Forest, the Attorney General expressed the view that a mere passer-by, seeing a fire burning in or near inflammable material on the public domain, is not

guilty of an offense under section 52 of the Penal Code for leaving the fire unattended. That section makes it a criminal offense to leave or suffer fire to burn unattended near any timber or other inflammable material on the public domain.

THE PLANT QUARANTINE ACT.

[37 Stat., 315.]

Eleven cases were reported to the Attorney General, 10 under section 8 (domestic quarantines) of the act as amended by the appropriation act of March 4, 1917 (39 Stat. 1134, 1165), and 1 under section 7 (foreign quarantines).

At the close of the fiscal year 1917, 23 cases were pending. Sixteen of these and 1 reported during the year 1918—in all 17 cases—were terminated during the year. Of these, 13 were dismissed because of the court decision referred to below. In 4, convictions resulted with fines aggregating \$95. Three were closed on pleas of *nolo contendere* and 1 on a plea of guilty. At the close of the year 17 cases were pending.

A number of proposed orders of the Secretary of Agriculture to establish, and of regulations to enforce, quarantines under the law were examined as to their legal form and sufficiency.

An item of legislation, adopted by Congress, was drafted at the request of the Federal Horticultural Board, providing that any moneys received in payment of charges fixed by the Secretary of Agriculture on account of cleaning and disinfecting railway cars and other vehicles employed in the movement of cotton and cotton seed from Mexico into the United States, at plants constructed for such purpose, out of any appropriation made on account of the pink bollworm, should be covered into the Treasury as miscellaneous receipts.

COURT QUARANTINE DECISION OF INTEREST.

In *United States v. Boston-Maine Railroad Co.* (Plant Quarantine No. 19), the circuit court of appeals for the first circuit held, in substance, that while lumber is in a sense a plant product it was not within the prohibition of the plant quarantine act. Since similar cases arising subsequent to the act of March 4, 1917 (39 Stat., 1134, 1165), amending section 8 of the act, can be prosecuted by virtue of the amendment, it was believed that no good purpose would be subserved by appealing the case to the United States Supreme Court. In view of this decision, 13 like cases were recommended for dismissal.

FEDERAL AID ROAD ACT.

[39 Stat., 355.]

Project statements for 663 projects were reviewed during the year to determine whether the projects were eligible for aid under the provisions of the act. Of these, 559 were approved and 4 disapproved. In many cases where some part or all of the project was not being used as a rural post road and there was not sufficient evidence to establish a reasonable prospect that it would be so used within a reasonable time, it was necessary to point out in detail the character of additional evidence which should be furnished to establish the eligibility of the project. In some instances elimination of a portion or portions of the project was suggested, where it was impossible to furnish sufficient evidence of a reasonable prospect of use

for mail transportation. Project agreements and certificates of approval of plans, specifications, and estimates drafted by the Office of Public Roads and Rural Engineering for 218 projects, including 13 for which project statements were approved during the previous fiscal year, were examined as to their legal form and sufficiency, and subsequently as to whether they were properly executed. These agreements involved a total estimated expenditure of \$14,239,939.15, and Federal aid aggregating \$5,658,458.42. Project statements reviewed, but for which project agreements had not yet been executed at the close of the year, involved a total estimated expenditure of \$28,038,831.23, and Federal aid to the amount of \$10,391,363.32. Modifications of agreements were similarly reviewed in 11 cases. The projects for which project agreements were entered into and project statements approved during the year represent an aggregate estimated cost of \$42,278,770.38 and Federal aid to the extent of \$16,049,821.74, the total road mileage being 6,249.3965. Also 49 original and supplementary cooperative agreements, under section 8 of the act relating to roads and trails within national forests, were examined as to legal form and sufficiency.

Statutes of 10 States assenting to the provisions of the act were reviewed to determine whether they meet the requirements of the act. The legislation of two States was reconsidered for the purpose of determining definitely whether they had State highway departments when the act was passed. The first regular session of the Legislature of Mississippi held after the passage of the act having adjourned without assenting to its provisions, the legislation of the State was reviewed and the opinion expressed that the State had previously signified its assent by a resolution of its legislature indorsing the act when it was pending before Congress and by a subsequent statute creating a State highway department with power to do, so far as possible under the constitution of Mississippi, the things required by the act.

Proposed standard plans, specifications, notice to bidders, and contract and bond forms for use by a number of the States in carrying out the cooperation contemplated and authorized by the act, which were submitted for consideration by the several State highway departments, were reviewed as to their legal form and sufficiency. Suggestions as to changes in form and substance were made in several instances. Similar forms for the use of the department, under section 8 of the act, and also as guides for the States under the post-roads provisions of the act, were likewise reviewed. Forms of resolutions to be used by the counties and other civil subdivisions in applying to their respective State highway departments for State and Federal aid, in accordance with the State laws, were drafted for the convenience of the State highway departments concerned.

Proposed amendments to the regulations were reviewed as to their legal form and sufficiency, and opinions were rendered on a number of important questions arising under the act.

A memorandum prepared by the Office of Public Roads and Rural Engineering as a guide for its engineers and the State highway departments in the submission of projects was revised to indicate the percentage of nonpost route which might be included in the project

under varying conditions and the character of evidence which should be submitted to establish a reasonable prospect that unused portions would be used for mail transportation within a reasonable time. This memorandum, known as Engineering Memorandum No. 5, has proved very helpful.

WEEKS FORESTRY LAW.

[36 Stat., 951.]

Although the area of lands acquired under the Weeks forestry law during the year is not as large as in the fiscal year 1917, it was greater than in any other year since the law has been in operation. The diminution in acreage acquired during the year was due very largely to war conditions, which drew from the work of examining titles four of the title attorneys and a number of experienced stenographers and typewriters; and the United States attorneys were unable to devote as much attention to their reports upon the titles because of increased work cast upon them by various recent statutes affecting the preparation for and conduct of the war.

On account of congestion of work in the offices of the United States attorneys, the National Forest Reservation Commission has restricted the consideration of new purchases of lands to those within various areas heretofore established by the commission and to such bordering lands as were deemed necessary for the proper administration of the national forests to be established.

The following is a summary, in terms of acres, of operations under the Weeks law from the beginning to June 30, 1918:

Operations under the Weeks forestry law from the beginning to June 30, 1918.

State.	Area.	Purchases authorized (estimated).	Purchases completed (actual survey).	Reports in Department of Justice.	
				For opinion (actual survey).	For condemnation (actual survey).
		<i>Acres.</i>	<i>Acres.</i>	<i>Acres.</i>	<i>Acres.</i>
Alabama.....	Alabama.....	57,706.30	27,746.34	1,460.35	3,831.79
Arkansas.....	Arkansas.....	440.00			
	Ozark.....	557.00			
Georgia.....	Georgia.....	60,233.72	59,971.36		
	Savannah (S.).....	47,660.73	35,998.32		11,420.21
Maine.....	White Mountain.....	29,413.91	24,993.77		
New Hampshire.....	do.....	371,819.39	275,969.04		58,756.86
North Carolina.....	Boone.....	47,969.61	25,736.77		19,310.80
	Mount Mitchell.....	75,672.88	55,039.19	7,402.86	6,025.76
	Nantahala.....	84,028.10	34,016.20	239.81	390.10
	Pisgah.....	88,202.51	77,044.71	13.63	
	Savannah.....	37,409.43	31,922.33		3,726.02
South Carolina.....	Savannah (S.).....	18,454.26	17,380.87		679.78
Tennessee.....	Cherokee.....	137,743.40	91,363.95	11,409.08	1,053.83
	Smoky Mountain ¹				
	Unaka.....	51,172.50	11,853.95		28,940.18
	White Top.....	47,166.89	40,905.82	307.68	6,261.07
Virginia.....	Massanutten.....	58,281.41	38,388.58	171.81	16,959.17
	Natural Bridge.....	106,107.62	73,596.84	3,483.69	2,342.25
	Potomac.....	41,114.36	23,155.63		13,899.44
	Shenandoah.....	152,146.32	87,158.90		17,967.99
	White Top.....	22,404.31	11,358.38	10,251.37	486.88
West Virginia.....	Monongahela.....	54,016.58	44,920.36		
	Potomac.....	38,383.47	30,954.10		4,158.25
	Shenandoah.....	13,700.76	13,318.45		
Total.....		1,641,805.46	1,158,396.13	34,740.28	196,209.38

¹ Includes 13,656.68 public lands.

THE FOOD AND DRUGS ACT.

[34 Stat., 768.]

Seven hundred and ninety-seven cases were transmitted to the Department of Justice, in 337 of which criminal proceedings and in 460 of which seizures were recommended. The 337 criminal cases embraced 631 alleged violations of the food and drugs act.

At the close of the fiscal year 1917, 313 cases were pending, of which 213 were criminal prosecutions and 100 were seizures.

Two hundred and forty-three cases pending at the close of the fiscal year 1917 and 469 reported during the fiscal year 1918, in all 712, were terminated in 1918. Of those terminated, 362 were criminal and 350 were civil.

In 311 of the 362 criminal cases fines were imposed. Most of these cases were disposed of by pleas of guilty or nolo contendere. There were trials in only 7; in 5 collateral deposited by defendants was forfeited by reason of their nonappearance in court; in 1 the judgment of conviction in the lower court was affirmed by the circuit court of appeals; in 1 the Supreme Court of the United States reversed the judgment of the lower court, which sustained a demurrer to the indictment, and in another it affirmed the judgment of the circuit court of appeals, which affirmed the judgment of conviction in the trial court; in 2 there were acquittals; 33 were nolle prossed or the informations dismissed; and 8 were withdrawn or barred by the statute of limitations.

In the criminal cases in which convictions were obtained the fines were as follows:

Fines assessed under food and drugs act in cases reported by this department to the Department of Justice.

Number of cases.	Amount of fine.	Total.	Number of cases.	Amount of fine.	Total.
2	\$1.00	\$2.00	1	\$125.00	\$125.00
11	5.00	55.00	4	150.00	600.00
21	10.00	210.00	1	180.00	180.00
9	15.00	135.00	13	200.00	2,600.00
40	20.00	800.00	1	210.00	210.00
59	25.00	1,475.00	2	250.00	500.00
5	30.00	150.00	2	300.00	600.00
1	35.00	35.00	2	350.00	700.00
12	40.00	480.00	1	375.00	375.00
1	45.00	45.00	2	400.00	800.00
78	50.00	3,900.00	1	500.00	500.00
3	60.00	180.00	1	700.00	700.00
10	75.00	750.00			
33	100.00	3,300.00	316 ¹	.....	19,407.00

¹ This number represents 589 violations of the food and drugs act.

In addition to the fines imposed costs were generally assessed.

Of the 350 civil cases terminated during the year decrees of condemnation and forfeiture or informal orders for the disposition of the property were entered in 325, of which 1 was decided favorably to the Government after contest; in 3 the libels were dismissed; in 21 the packages were broken or disposed of before seizure could be

made; and in 1 a verdict was returned for the claimant after trial to the court and a jury. In the 325 cases in which decrees of condemnation and forfeiture were entered the goods were destroyed in 133; released on bond or otherwise in 166; and sold in 26. In many of the cases in which the product was ordered released or sold, the decree of the court provided that the product should be sorted and that that portion found unfit for food should be destroyed.

At the close of the year 398 cases were pending, of which 188 were criminal prosecutions and 210 were seizures.

In addition to the cases reported by this department to the Department of Justice the food and drugs officials of the various States and of the District of Columbia, collaborating with the department in the enforcement of the act, are shown by the records of this office to have reported 95 cases to the United States attorneys which were terminated during the year. Of these 57 were criminal cases and 38 were seizures. In all of the criminal cases there were convictions or the collateral deposited by defendants was forfeited on account of their nonappearance. In all of the seizure cases decrees were entered and the products released on bond in 18 cases, destroyed in 12, and ordered sold in 7 cases. The fines or amounts forfeited as collateral in the criminal cases were as follows:

Fines in food and drug cases begun by United States attorneys.

Number of cases.	Amount of fines.	Total.	Number of cases.	Amount of fines.	Total.
7	\$10.00	\$70.00	4	\$50.00	\$200.00
3	15.00	45.00	1	100.00	100.00
32	20.00	640.00	1 ¹	.....	.....
8	25.00	200.00			
1	30.00	30.00	57	.....	1,285.00

¹ Released on personal bond.

One thousand two hundred and fifty notices of judgment were published during the year.

FOOD AND DRUGS CASES OF INTEREST.

In *United States v. Herman Heimann*, Notice of Judgment 6120, involving an interstate shipment of milk, the court instructed the jury that the food and drugs act seeks to give to the people the natural product of food to which they are entitled and that whatever butter fat milk does contain the shipper should ship the whole milk without any abstraction of any part of it.

In *United States v. Union Dairy Co.*, Notice of Judgment 6142, involving another shipment of milk, the plaintiff in error contended that it was shipping the milk from a receiving station in Illinois to itself in Missouri, there to be treated, impurities removed, and the milk standardized; that while in transit it was not an article of food, such as was defined by the food and drugs act, and did not become such an article of food until after treatment. Upon this proposition the United States circuit court of appeals for the seventh circuit said that to adopt such a conclusion would do violence to the plain language of the statute. The court further said that in passing the food

and drugs act Congress was endeavoring to protect the public by keeping out of interstate commerce certain illicit articles debased by adulteration, and it would be an unjustifiable construction of the act to make liability turn upon a difference in identity of consignor and consignee, or the secret intent with which a shipper made the shipment.

In *United States v. McLean Medicine Co.*, Notice of Judgment 6149, involving the shipment in interstate commerce of a drug alleged to have been misbranded in violation of the Sherley amendment to the food and drugs act, the trial court instructed the jury that Congress enacted the food and drugs act for the purpose of protecting the health of the people. With regard to the labeling of the product, the court instructed the jury that for the purpose of determining whether the labels and other literature, which contained statements that the use of the medicine would arrest or retard the diseases mentioned therein, were misbranded, that they should take into consideration all the language used therein, and from it determine whether it was the intention of the defendant to lead such persons who would read them to believe that the preparation, if taken in the manner prescribed, would arrest or retard the progress of the numerous diseases mentioned although the language did not in direct terms say so; that persons who make substances or compositions alleged to be curative or beneficial are in a position to have superior knowledge and may be held to good faith in their statements; that a person who makes a statement which he doesn't know to be true makes a false statement just as much as a man who makes a statement which he knows to be false; that if a person makes false statements for the purpose of inducing another to purchase such preparations from him in the belief that they will cure or arrest, retard or relieve him to some extent from the ailments which he suffers, which he didn't know to be true and therefore were found to be false, then the jury were justified in finding that it was for the fraudulent purpose of inducing the people to buy the medicine from him; that if they found it to be a fact that the statements were not false, or, being false, that there was no intent, whether actual or implied, upon the part of the defendant to defraud, then their verdict should be for the defendant; that in determining the intent of the defendant, they should take into consideration all the facts and circumstances of the case and determine whether or not it was the intention that this language, interpreting it as ordinary intelligent men would, should convey the impression that the medicine was to cure or act as a remedy for the diseases or ailments mentioned, even where the language does not directly say so.

The case of *Oscar J. Weeks v. The United States* (F. & D. No. 4672, Cir. No. 89, Office of the Solicitor) decided by the Supreme Court of the United States February 4, 1918, involved a prosecution for the shipment in interstate commerce of an article of food labeled "Special lemon. Lemon terpene and citral." Upon the trial of the case a conviction resulted in the lower court, and in the circuit court of appeals the conviction was affirmed upon so much of the charge in the information as alleged that the article was offered for sale as lemon oil, when in truth it was an imitation thereof containing alcohol and citral derived from lemon grass. The record showed that

there was testimony tending to prove, among other things, that the shipment was made to fill an order solicited and taken by a traveling salesman in defendant's employ. The salesman had been supplied by the defendant with a sample bottle of the article which was labeled simply "Special lemon." In offering the article for sale and soliciting the order, the salesman exhibited the sample and represented that the article was pure lemon oil obtained by a second pressing, and that this pressing produced a good, if not the best, oil. The article was not lemon oil, but an imitation thereof containing alcohol and citral made from lemon leaves. Some of the elements of lemon oil were present in other than the usual proportions, and others were entirely lacking. The testimony respecting the salesman's representations was admitted by the trial court over the defendant's objection, and the court later denied defendant's request that the jury be instructed that this testimony could not be considered but only the statement appearing on the label when the bottle was shipped. In that connection the court told the jury that the defendant could not be held criminally responsible by reason of any representations made by the salesman, unless it appeared beyond a reasonable doubt that the same were made by the defendant's authority. The defendant complained, on appeal, of the admission and consideration of this testimony, and insisted that under the statute the question whether an article is misbranded, turns entirely upon how it is labeled when it is shipped, regardless of any representations made by a salesman, or even the vendor, in offering it for sale.

Upon this proposition the Supreme Court said:

It is apparent that the statute specifies and defines at least two kinds of misbranding, one where the article bears a false or misleading label and the other where it is offered for sale under the distinctive name of another article. The two are quite distinct, a deceptive label being an essential element of one but not of the other. No doubt both involve a measure of deception but they differ in respect of the mode in which it is practiced. Evidently each is intended to cover a field of its own, for otherwise there would be no occasion for specifying and defining both. That one article of food may be offered for sale in the distinctive name of another and the offer accomplish its purpose without the aid of a false or misleading label hardly needs statement. * * *

It follows that the testimony respecting the representations of the defendant's traveling salesman was rightly admitted in evidence and submitted to the jury. It tended to prove that the order, to fill which the shipment was made, was obtained by offering the article for sale, in the distinctive name of another article, and therefore that the article was misbranded within the meaning of the statute. To have confined the jury's attention to the label borne by the article when it was shipped, as was requested by the defendant, would have been to disregard the nature of the charge in the second count and the distinction between the two kinds of misbranding.

In *United States v. Schider* (Circular No. 91. Office of the Solicitor, Notice of Judgment No. 6151), the trial court sustained the defendant's demurrer to the indictment. On a writ of error to the Supreme Court of the United States the lower court was reversed and the case remanded. The indictment charged that a product containing little or no grape and labeled "Compound Ess Grape" was adulterated and misbranded in violation of the food and drugs act. The defendant contended that the labeling of the article "Compound" brought it within the proviso of section 8 of the act, which declares articles of food shall not be deemed adulterated or misbranded if they are "labeled, branded, or tagged so as to plainly indicate that they are compounds, imitations, or blends, and the word

‘compound,’ ‘imitation,’ or ‘blend,’ as the case may be, is plainly stated on the package in which it is offered for sale.”

With regard to the labeling the Supreme Court said that its obvious and undisputed purpose and effect was to declare the bottled article a compound essence of grape when in fact it contained nothing from grapes and was a mere imitation, and should therefore be deemed adulterated since some other substance had been substituted wholly for the one indicated by the label, and also misbranded, for the label carried a false and misleading statement.

With regard to the contention of the defendant the court said, “But we are unable to conclude that by simply using ‘compound’ upon his label a dishonest manufacturer exempts his wares from all inhibitions of the statute and obtains full license to befool the public. Such a construction would defeat the highly beneficent end which Congress had in view.” The court further said, “The stuff put into commerce by defendant was an ‘imitation,’ and if so labeled purchasers would have had some notice. To call it ‘compound essence of grapes’ certainly did not suggest a mere imitation, but on the contrary falsely indicated that it contained something derived from grapes. (See *Frank v. United States*, 192 Fed., 864.) The statute enjoins truth; that label exhales deceit.”

In *United States v. 720 cases of tomato catsup* (Notice of Judgment 6192), in which the article was alleged to be adulterated, the court charged the jury that in reaching a conclusion as to whether or not the law was violated they should accept in the common ordinary everyday sense the words “filthy,” “decomposed,” and “putrid”—that is to say, filthy is usually considered to be nasty or dirty, decomposed is usually considered to be rotten, and putrid has a somewhat similar meaning in everyday life, rotten or emitting a vile odor; “just the meaning that you gentlemen would give to these words in your daily lives.”

It was further charged, if the article consists in whole or in part of a filthy or decomposed vegetable substance, that it was unnecessary for it to be unfit for food, to constitute a violation of the food and drugs act.

In *United States v. Direct Sales Co.* (Notice of Judgment 6193), in which the defendant entered a plea of guilty to shipment in interstate commerce of seven different articles of drug which were adulterated and misbranded, the court ruled, upon the question as to the amount of fine to be imposed, that the article is clearly specified in the food and drugs act as the unit of the offense, as distinguished from the shipment and that in this case, involving seven different articles, each adulterated and misbranded, that there were 14 separate and distinct violations of the act, for which separate penalties might be imposed.

Upon defendant’s contention that separate offenses committed at one and the same time are inspired by one criminal intent and that therefore but one punishment may be imposed, the court held that that rule did not strictly apply, as the food and drugs act specifically designates the articles as the item, the transportation of which is prohibited. The court also held that the misbranding and adulteration in this case constituted concurrent offenses in answer to defendant’s contention that the imposition of a penalty in excess of \$200 would be the imposition of a penalty for a subsequent offense.

The case of *United States v. Johnson et al.* (Notice of Judgment No. 5982), involved a charge of adulteration and misbranding of an article shipped in interstate commerce which was labeled "Maple etta syrup," with the word "Maple" in large letters, the word "Etta" in smaller letters underneath it and to the right, without any hyphen, and the word "Syrup" in a little larger letters than the word "Maple." Below that were the words in much smaller type, "Produced by the blending of refined sugar syrup, cane, and maple etta syrup," with the design of maple leaves or something in the nature of maple leaves around the word "Maple." The court instructed the jury that the question for their determination was whether the label, taken as a whole, as it was upon the can and offered to the purchaser for sale, was reasonably calculated to deceive and mislead the average purchaser into the belief that he was getting maple sirup; that it was not a question as to whether any purchaser had been actually deceived or not; that the Government did not have to show that; that it was not a question as to what a very careful man would do about it or would think about it, or what a very careless man would think about it; that they were to take into consideration all of the circumstances bearing on that question, the label itself, the placing of the letters, the size of the letters, and determine what would be the natural effect of that label on the ordinary average person.

United States v. Bethesda Mineral Spring Co. (Notice of Judgment No. 5906), involved the shipment of water for which certain therapeutic claims were made and which the evidence showed was radioactive in an infinitesimal degree. Upon the question as to the relevancy of evidence respecting the radioactivity of the product, the court held that the question of its radioactivity was not relevant to the issues in the absence of testimony by the defendant showing the effect that the infinitesimal quantity present would have on the diseases enumerated on the label.

The article was labeled "Bethesda: For all kidney diseases, Bright's disease, diabetes, torpid liver, dyspepsia, insomnia, calculi, or nervous prostration."

The court charged the jury that they were to test what the label meant by taking the language of it and importing to that language the meaning of the words, singly and together, that would be conveyed to them as ordinary men; not as men skilled in medical, chemical, or pharmaceutical science, capable of making nice distinctions or nice discriminations, but rather the meaning that would come to them as ordinary men unskilled, but seeking, it is assumed, some sort of remedy or remedial help for the afflictions that flesh is heir to; that they should examine the language in the light of the purpose of the food and drugs act, which is to protect human kind against the consequences of human weaknesses or human frailty, of human credulity or the disposition to believe, or of human gullibility; that they should handle it in the light of the disposition of the ordinary human kind to wish to believe in the potency of remedial agents to relieve them from ills from which they are actually or conceivably suffering.

The court further instructed the jury that if they found it to be a fact that the former label used the word "cure," that they would

have a right to consider why the change was made and why no other change was made than merely from the word "cure" to the word "for"; in other words, whether that is not merely a colorable change designed for the purposes of leaving the statements at best equivocal.

The court also stated that in his judgment the label did mean and was intended to mean that the article was curative.

With regard to evidence introduced to show that water was helpful in the treatment of certain diseases, the court stated that that fact was a long way from importing truth into this label as a representation of the virtues of a drug. The court further stated that the law exacts, in the carrying on of its high purposes, that the label should square—should cover not only the package but the ascertainable truth respecting its contents and that this law was not to be frustrated or made uncertain of application or to be regarded as being without standards merely because as to any ingredients, food, drugs, liquids, or solids, an individual may be able truthfully to say that it was helpful to him. It was further charged that the jury were not required to believe that it was possible to label water, such as came from Lake Michigan, as a drug and not offend against the food and drugs act.

With regard to testimony introduced on behalf of the defendant to the effect that the curative properties of the water could not be known except through use, the court instructed the jury that it did not apply to them, as men of good sense, to say, in a case where an article was shown to have certain definite proportions of a drug or a chemical or of a mineral, that they could form no practical idea in advance as to whether it has any curative effect.

It was further charged that to say that this label was a fraudulent one does not mean that the one who put it out, or the defendant corporation, as between itself and the individual who bought a bottle of the water, had a personal malicious scheme or design to get money out of it, but that it was the idea of practicing a deception through a statement, through a practice, through an act which, in the light of attending circumstances, shows that the one who made the statement or committed the act ought to have known better, producing damage by deceiving somebody, and therefore a mere open or reckless disregard of the truth may constitute fraud just as much as a personal malicious design to do an act that hurts another.

Upon the question of reasonable doubt the court instructed the jury that it did not mean, for example, that they might recognize the mere possibility that somebody had been cured, as he believed, by this water.

In *United States v. Roberts Cotton Oil Co.* (Notice of Judgment No. 5909) the defendant company had placed tags on cottonseed meal in accordance with the instructions of the purchaser, thus misbranding it and then shipped it in interstate commerce. Upon the contention of the defendant that the act of misbranding was not its act, but that of the man whose tags they placed on the feed, the court ruled that it was the act of the defendant company.

In *United States v. Early & Daniel Co.* (Notice of Judgment No. 6210), in which an information was filed by the district attorney by virtue of his office without verification and without supporting affidavits and in which no warrant for arrest was sought, upon the mo-

tion of the defendant company to strike the information from the docket, because not filed by leave of court first had, the court, in denying said motion, held that there is no statute on the subject and that the question becomes one of practice rather than one of right, and, as a matter of practice, in accordance with the views expressed in *Weeks v. United States*, no leave of court is necessary before the information is filed in such a case as this; that if no constitutional right of the defendant is affected by an information filed by the district attorney, not supported by affidavit showing probable cause, except in cases in which a warrant for arrest is sought, the defendant can not have a constitutional right to require the district attorney to obtain leave of court before filing an information when no warrant of arrest is sought.

The case of *United States v. A. Skarzynski* (Notice of Judgment No. 6125), involved the shipment in interstate commerce of a so-called Wine of Chenstohow, which was labeled, in part (on wrapper), "Medicinal compound the best remedy for the stomach," (on bottle) "Those who suffer from loss of strength, indigestion, piles, pains, etc., should use the curative Wine of Chenstohow."

In the charge to the jury the court stated that the food and drugs act was passed by Congress for the purpose of prohibiting the sale of impure foods and drugs and forbidding the misbranding of the same; that the object was to prevent the sale of commodities in interstate commerce that are harmful to the health of the people and to prevent them from being defrauded by adulterated foods, drugs, and liquids, also to prevent the misbranding or false labeling of such articles, so that the buyer should know that the article bought by him was what it purported to be; further, that the purpose of this suit is to safeguard the unwary public from being deceived, and from buying such commodity which would not of itself give the benefit promised by the seller and as indicated by the labels and wrappers; and that violators of this statute can not be permitted to defraud the public by placing upon the market spurious foods or drugs or beverages or placing upon the market foods or beverages and mislabeling them, to the end that the buying public may be led to believe that the contents of the package, if the drug or beverage is contained in packages, contains something different than they intended to purchase.

The jury was instructed that, if the words contained in the above-quoted labeling are to be taken in the broad sense, the product in question is misbranded on account of their evident falsity; if the meaning is restricted, as the defendant claims, to conditions of the stomach as distinguished from organic troubles, and such condition is benefited or cured by the product, then the defendant company is not guilty. In other words, the jury should consider and determine the meaning of those words and whether the defendant company meant by the wording on the label that the public should understand that the product would remedy or cure all stomach troubles, in the broad sense, which would include organic troubles of the stomach, or did it simply mean to be understood, and want the public to understand by the label and wrapper, that the reference was to temporary or symptomatic conditions of the stomach, such as do not arise from a diseased condition or an organic condition of the stomach.

The jury was further instructed that if they concluded the product was misbranded and that the label and wrapper were false and intended to mislead, before there may be a conviction they must determine whether the defendant company was aware of the falsity of the wording, or knew it was untrue, and used the wording on the label carelessly and recklessly without sufficiently apprising itself of the true facts, and marketed the product with the view of getting money fraudulently from the public for an article which could not give or render a specific result.

The jury was instructed that the word "remedy" is known to signify something that cures a disease, something taken internally to alleviate disease and benefit the health.

The jury was further instructed that the Government is required to prove, not only that the commodity was misbranded, as claimed by it, not only that it was too broad and not limited or restricted in its wording, but that it was the intention of the defendant to deceive the public, and that it knew when the branding was appended to the bottle that it was false, and that if they reach the conclusion that there was a misbranding, but there was no intention to foist upon the public this commodity with the view of gain, then the defendant is entitled to an acquittal on the ground that there was no intention to violate the statute, and, without the intention being present, there can be no conviction.

The following additional charges were allowed by the court:

1. That the state of mind—on the question of the intent of the defendant—the state of mind is itself a fact, and may be a material fact, and false and fraudulent representations may be made about it, bearing on what he thought or knew of the ingredients, and persons who make or deal in substances or compositions alleged to be curative are in a position to have superior knowledge, and may be held to good faith in their statements.

2. That the article alone is not necessarily the inducement and compensation for its purchase, that it is the use to which it may be put, and the purpose it may serve, and there is a disposition to defraud when the article is not of the character or kind represented, and hence does not serve the purpose.

3. That the usual meaning of the word "remedy," as a matter of law, is that which cures disease, any medicine the application of which puts an end to disease and restores health.

4. That the word "curative" is to be taken in the usual sense on this bottle and that the usual sense of the word "curative" is that which cures, a remedy.

5. That another recognized definition of "remedy" is "curative tendency only, and not a guarantee."

MEAT INSPECTION.

[34 Stat., 674.]

Twenty-nine cases were reported to the Attorney General, as against 271¹ cases reported during the preceding year, a decrease of 242 cases.

At the close of the fiscal year 1917, 244 cases were pending.

Of the cases reported during the fiscal year 1918, 7, and of those pending at the close of the fiscal year 1917, 217, in all 224, were terminated during the fiscal year 1918. Of these 85 resulted in convictions, 126² were dismissed, 1 resulted in a verdict for the defendant, and in 9 grand juries refused to return indictments.

¹Of these, 183 cases were grouped against 4 defendants
²Of these, 124 cases were grouped against 2 defendants.

Fines aggregating \$758.25 were imposed in 87 cases, as follows:

Fines imposed in meat-inspection cases.

Cases.	Fine.	Total.	Cases.	Fine.	Total.
6	\$5.00	\$30.00	5	\$50.00	\$250.00
1	5.25	5.25	59	83.00	83.00
4	10.00	40.00	1	100.00	100.00
1	15.00	15.00			
3	20.00	60.00	87	.....	758.25
7	25.00	175.00			

¹ These cases were consolidated against one defendant and one fine imposed.

At the close of the fiscal year 1918, 49 cases were pending.

TWENTY- EIGHT HOUR LAW.

[34 Stat., 607.]

One thousand one hundred and sixty-eight cases were reported to the Attorney General for prosecution.

At the close of the fiscal year 1917 2,518 cases were pending.

Of the cases reported during the fiscal year 1917, 595, and of the cases reported during the fiscal year 1918, 7, in all 602 cases, were terminated by the imposition of fines. Two hundred and forty-nine cases were terminated by dismissal, and 4 were decided adversely to the United States.

June 30, 1918, 2,831 cases were pending.

During the year penalties aggregating \$64,925 were collected in 602 cases.

Following is a detailed table of the number of cases prosecuted and the amounts of penalties assessed:

Cases prosecuted and fines imposed under the twenty-eight hour law.

Number of cases.	Fine	Total amount.	Number of cases.	Fine.	Total amount.
449	\$100	\$44,900	12	.....	\$225
12	125	1,500	16	.....	400
10	150	1,500	15	.....	625
1	175	175	16	.....	875
12	200	2,400	16	.....	700
5	250	1,250	16	.....	500
1	500	500	16	.....	700
14	50	700	13	.....	200
4	75	300	12	.....	325
35	.....	5,050	13	.....	200
16	.....	800			
18	.....	1,100	602	.....	64,925

Lump fine.

TWENTY- EIGHT HOUR LAW COURT DECISIONS.

Among the cases of interest decided during the year were *Philadelphia & Reading Railway Co. v. United States* (247 Fed., 466), *United States v. Philadelphia & Reading Railway Co.* (247 Fed., 469), and *Grand Trunk Western Railway Co. v. United States* (248 Fed., 905).

ACTS REGULATING THE INTERSTATE MOVEMENT OF LIVE STOCK FROM QUARANTINED DISTRICTS, PROHIBITING THE INTERSTATE MOVEMENT OF DISEASED LIVE STOCK, AND PROHIBITING THE IMPORTATION OF DISEASED LIVE STOCK.

[23 Stat., 31; 26 Stat., 414; 32 Stat., 791; 33 Stat., 1264.]

Three cases involving violations of the act of May 29, 1884 (23 Stat., 31), were reported to the Attorney General. All of these were pending at the close of the year.

No cases were reported to the Attorney General under the act of August 30, 1890 (26 Stat., 414). In one case pending at the close of the fiscal year 1917 the defendant could not be located, and the case was nolle prossed.

One hundred and one cases were reported to the Attorney General under the act of February 2, 1903 (32 Stat., 791). At the close of the fiscal year 1917, 16 cases were pending, and sentence stood suspended in 1. Ten cases reported during the year and 5 pending at the close of the fiscal year 1917, in all 15, were terminated. Eleven resulted in convictions upon which fines aggregating \$1,100 were imposed; in three cases grand juries failed to indict, and one case was dismissed; 102 cases were pending at the close of the year.

Two hundred and eighty-one violations of the act of March 3, 1905 (33 Stat., 1264), were reported to the Attorney General. At the close of the fiscal year 1917, 170 cases were pending. Sixty-seven cases pending at the end of the fiscal year 1917, and 49 cases reported during 1918, in all 116, were terminated. One hundred and thirteen cases were terminated by conviction, upon which fines aggregating \$11,650 were imposed; 2 were dismissed; and in 1 the defendant could not be located, and the case was nolle prossed; 335 cases were pending at the close of the year.

In each of the cases reported to the Attorney General under the acts of February 2, 1903, and March 3, 1905, a suggested form of indictment or criminal information was prepared and submitted therewith for use by the United States attorney in the prosecution.

The fines imposed in cases under the animal quarantine laws were:

Fines imposed under the animal quarantine laws.

Number of cases.	Amount of fines.	Total.
119	\$100	\$11,900
2	125	250
3	200	600
124	.....	12,750

THE VIRUS ACT.

[37 Stat., 832.]

Three apparent violations of the act of March 4, 1913 (37 Stat., 832), governing the preparation, shipment, and importation of viruses, serums, toxins, and analogous products intended for use in the treatment of domestic animals were reported to the Attorney General. These cases were pending at the close of the fiscal year.

In several cases involving the suspension or revocation of licenses issued by the Secretary to manufacturers of these products, the testimony given at the hearings was reviewed by this office and the Secretary advised as to its legal effect.

THE INSECTICIDE ACT.

[36 Stat., 331.]

One hundred and twenty-three cases were reported to the Attorney General, in 117 of which criminal proceedings and in 6 seizures were recommended. At the close of the fiscal year 1917, 44 cases were pending, of which 41 were criminal prosecutions and 3 were seizures. Forty-four cases pending at the close of the year 1917 and 30 reported during the year 1918, in all 74, were terminated during the year. Of the cases terminated 69 were criminal and 5 civil. In the 69 criminal cases 8 violations were combined with others for the purposes of prosecution; fines were imposed in 55; 4 were dropped or dismissed. After the combination for purpose of prosecution in 58 pleas of guilty, in 5 pleas of nolo contendere, and in 2 pleas of not guilty were entered.

In the criminal cases in which convictions were obtained the fines were as follows:

Fines imposed under the insecticide act.

Number of cases.	Amount of fine.	Total.	Number of cases.	Amount of fine.	Total
1	\$1	\$1	1	\$50	\$50
1	5	5	2	75	150
15	10	150	3	100	300
2	15	30	2	200	400
4	20	80	1	300	300
18	25	450	1	400	400
3	30	90			
1	40	40	55	.....	2,446

Costs were assessed in a number of cases in which convictions were obtained. Decrees of condemnation and forfeiture were entered in 4 civil cases, and 1 case was dismissed. At the close of the year 93 cases were pending, of which 89 were criminal prosecutions and 4 were seizures. One hundred and twenty-two notices of judgment were prepared.

THE LACEY ACT.

[35 Stat., 1137.]

Thirty-eight cases were reported to the Department of Justice. At the close of the preceding fiscal year 37 cases were pending, of which 22 were closed during this year, 21 by convictions and the imposition of fines, and 1 because the defendant could not be found.

Of the 38 cases reported during the year 27 were closed. In 25 defendants were convicted and fined; in 1 the defendant was committed to jail in default of payment of the fine; and in 1 sentences were suspended after pleas of guilty. In the latter case one defendant had already been confined in jail for several days and had been subjected to expenses amounting to several hundred dollars on account

of the prosecution. Twenty-six cases were pending at the close of the year. Fines were imposed as follows:

Fines imposed under the Lacey Act.

Number of cases.	Amount of fine.	Total.	Number of cases.	Amount of fine.	Total.
2	\$5	\$10	8	\$50	\$400
1	8	8	8	100	800
5	10	50	4	200	800
3	15	45	1	420	420
5	20	100	46	.....	2,873
8	25	200			
1	40	40			

In addition to the fines and the jail sentences, defendants were compelled to pay substantial costs.

BIRD RESERVES TRESPASS LAW.

[35 Stat., 1104.]

Twenty-seven cases were reported to the Department of Justice. Of the 27 cases reported during the year, 7 were closed by convictions and the imposition of fines. Twenty-one cases, including 1 coming over from the preceding year, were pending at the close of the year.

Fines imposed under the bird reserves trespass law.

Number of cases.	Amount of fines.	Total.
5	\$5	\$25
2	10	20
7	.....	45

UNITED STATES COTTON FUTURES ACT.

[39 Stat., 476.]

Assistance was given the Bureau of Markets in the consideration of 146 disputes under the act, involving 6,895 bales of cotton, the total costs assessed amounting to \$2,202.30. One amendment to the regulations was prepared. Consideration was given to the establishment and promulgation of standards for grades of American, Egyptian, and sea island cotton, and for length of staple, together with revision of the charges made for practical forms of existing standards.

Various opinions relating to the statute, distributed through the Bureau of Markets, were prepared or reviewed.

UNITED STATES GRAIN STANDARDS ACT.

[39 Stat., 482.]

Assistance was given the Bureau of Markets in drafting tentative standards for oats and in the revision of the standards for shelled corn and wheat and of the regulations under the act.

The records in 1,458 appeals and 12 disputes, involving the grading of shelled corn and wheat under the act, were reviewed. Examination was made of 155 forms of inspection certificates submitted by licensed inspectors, together with incidental correspondence. Con-

sideration was given to the suspension of 47, the revocation of 2, and the cancellation of 33 licenses of inspectors under the act, and related correspondence, orders, and other papers were reviewed or prepared. In proceedings against inspectors and in alleged violations of the act by shippers notices were prepared and the records reviewed upon request of the Bureau of Markets.

Approximately 140 opinions on questions arising in the administration of the act and the regulations were prepared, revised, or approved, and 10 Service and Regulatory Announcements and 14 information bulletins of the Bureau of Markets, containing opinions and information relative to the act, were examined and changes suggested when necessary.

The second semiannual publication, required by the act, of certain facts reported by licensed inspectors and furnished by grain warehousemen was passed upon.

UNITED STATES WAREHOUSE ACT.

[39 Stat., 486.]

In cooperation with the Bureau of Markets, and after conferences with trade representatives and a series of public hearings, regulations for cotton warehouses under the act were drafted. Assistance was given in the preparation of 20 forms for use in the administration of the act and the regulations. In addition assistance was given the Bureau of Markets in investigations in seven markets preliminary to the preparation of regulations for tobacco and grain warehouses.

STANDARD CONTAINER ACT.

[39 Stat., 673.]

By its terms this act came into force on November 1, 1917. In cooperation with the Bureau of Markets, regulations to carry the act into effect and instructions to inspectors engaged in its enforcement, together with required forms, were drafted.

FOOD CONTROL ACT.

[40 Stat., 276.]

Aside from the licensing and other activities under this act mentioned in the summary of this report, two contracts were prepared covering the purchase by the department of approximately 120,000 tons of nitrate of soda in Chile. This office participated with the War Industries Board in the preliminary conferences and negotiations which resulted in securing this nitrate. Assistance was given the Bureau of Markets in developing a plan for the allotment, sale, and delivery of the same to farmers, and in the preparation of a circular of information, application forms, and letters of instruction to banks and distributors. The status of the fertilizer tax laws in all of the States was investigated and legal questions involved in alleged shortages in deliveries of nitrate were considered.

Alleged unfair cancellation of certain contracts by a fertilizer company, involving the sale and future deliveries of nitrate of soda, was investigated through correspondence, conferences, and hearings, which resulted in reinstatement of certain of the contracts and a saving to purchasers thereunder of a large sum of money.

Consideration was given to a scheme of a fertilizer company in marketing an alleged plant food or fertilizer with a view, if warranted, to the revocation of the company's license under the act.

FOOD PRODUCTION ACT.

[40 Stat., 273.]

Assistance through conferences and opinions was given to the officers of the department engaged in the purchase and sale of seed to farmers.

The so-called food products inspection law consists of provisions included in the food production act for inspections by agents of the Secretary of Agriculture of fruits, vegetables, and other food products under certain conditions.

Assistance was furnished the Bureau of Markets in putting the law into operation, including the preparation of regulations, forms of application and certificate, instructions to inspectors, and service and regulatory announcements containing information relative to the law and the regulations. A revision of existing regulations was made anticipatory of the enactment of certain modifications of the law contained in the bill making appropriations for the Department of Agriculture for the fiscal year 1919.

Aid was furnished in the preparation of 18 schedules for food surveys, together with incidental orders, under section 2 of the act.

MISCELLANEOUS WORK FOR THE BUREAU OF MARKETS.

One hundred and twenty-five miscellaneous letters or memoranda, involving legal questions relating to the work of the Bureau of Markets, in addition to those specifically mentioned elsewhere in this report, were prepared, approved, or revised. Fifteen news items and manuscripts or proofs of 14 bulletins issued by the department were reviewed.

A form of general agreement for the conduct of cooperative work between State agencies and the department relative to marketing activities, and a form of contract for use between cooperative associations of farmers and their members were prepared.

Assistance was given in the drafting of specifications of commercial grades for white potatoes, sweet potatoes, strawberries, Bermuda onions, and tomatoes, and in the consideration of grades for cotton seed and butter.

GENERAL STATUTES.

At the close of the previous year there were pending 7 cases of violations of the general criminal laws of the United States reported to the Attorney General. During the present year 4 such cases were reported to the Attorney General. Of the cases reported this year and coming over from previous years, 3 were disposed of by conviction and the imposition of fines of \$100 each. At the close of the year 8 cases were pending either in the courts or in the Department of Justice.

PATENTS.

Forty-nine applications for letters patent on inventions of employees of the department for dedication to the public were prepared

and filed, an increase of 2 cases over the preceding year. During the year 34 were allowed and 3 disallowed.

The following table shows the status of applications on June 30, 1918:

Patents applied for by members of the department.

Applicant.	Bureau.	Invention.	Disposition of application.
Frank F. Chase.....	Plant Industry.....	Gravity fruit separator.....	Pending.
Marion Dorset and Howard J. Shore.	Animal Industry.....	Process for the manufacture of concentrated hog-cholera antitoxin.	Pending in interference.
Herbert C. Gore.....	Chemistry.....	Process for preserving fruit juices.....	Pending.
John F. Barghausen.	Plant Industry.....	Interlocking device.....	Allowed.
George A. Olson.....	States Relations Service.	Process for drying gluten.....	Do.
Chas. S. Reeves, Provost Hubbard, and Richard H. Lewis.	Public Roads and Rural Engineering.	Process for preparing water-proof paving material.	Pending in interference.
Peter A. Yoder.....	Plant Industry.....	Sirup evaporator.....	Allowed.
John H. Clack.....	Forest Service.....	Pack frame.....	Pending.
Ralph B. Adams.....	.....do.....	Portable telephone.....	Do.
John F. Barghausen..	Plant Industry.....	Machine for gathering crimson clover..	Allowed.
Otto Kress and Sidney D. Wells.	Forest Service.....	Process of cooking wood pulp.....	Do.
Wm. F. Oglesby.....	Plant Industry.....	Device for clipping olives and other fruit pits.	Do.
Kan Smith.....	Forest Service.....	Compass altimeter.....	Do.
Wm. R. Ross, Albert R. Merz, and John N. Carothers.	Soils.....	Process for the manufacture of a concentrated fertilizer.	Do.
Harry D. Gibbs and Geo. A. Geiger.	Chemistry.....	Process of manufacturing chlorine compounds.	Do.
Albert R. Merz, Wm. R. Ross, and John N. Carothers.	Soils.....	Method for the recovery of phosphorous fumes evolved in the volatilization method of treating phosphate rock.	Pending.
Frederick H. Colburn.	Forest Service.....	Improvement in relief alidades.....	Allowed.
Wm. B. Osborne, jr..	.....do.....	Device for locating the range of distant objects.	Pending.
James E. Imrie.....	.....do.....	Dry kilns.....	Do.
Albert R. Merz and Wm. R. Ross.	Soils.....	Process for the extraction of potash and alumina from alunite.	Do.
Harry D. Gibbs.....	Chemistry.....	Oxidizing the side chains of aromatic hydrocarbons.	Do.
Robert E. Prince and Otto Kress.	Forest Service.....	Process for fireproofing paper.....	Do.
Marion Dorset and Robert R. Henley.	Animal Industry.....	Process for separating serum from the corpuscles of mammalian blood	Allowed.
Robert C. Palmer.....	Forest Service.....	Process of destructively distilling wood.	Do.
Do.....	.....do.....	Method of destructively distilling wood.	Do.
John R. Carothers and Wm. R. Ross.	Soils.....	Smelting of phosphate rock.....	Pending.
Logan Waller Page...	Public Roads and Rural Engineering.	Concrete.....	Do.
Harry D. Gibbs and Courtney Conover.	Chemistry.....	Process for the manufacture of phthalic anhydride, etc.	Do.
Edmund B. McCormick.	Public Roads and Rural Engineering.	Recorders.....	Allowed.
Clyde H. Teesdale and Robert E. Prince.	Forest Service.....	Process of fireproofing wood.....	Do.
Wm. V. Cruess.....	.....do.....	Process for pickling olives.....	Disallowed.
Clyde H. Teesdale....	Forest Service.....	Process of treating wood.....	Pending in interference.
Norman De W. Betts and Harry D. Tiemann.	.....do.....	Dry kilns.....	Pending.
Edward J. Hoff.....	Public Roads and Rural Engineering.	Automatic weir for regulating the flow of water.	Allowed.
Victor M. Cone.....	.....do.....	Venturi measuring flumes.....	Pending.
J. F. Collins.....	Plant Industry.....	Method of filling cavities made by excavating the decayed or injured spots in a living tree.	Do.
Do.....	.....do.....	Method of treating decayed spots in living trees.	Allowed.
Harry D. Tiemann...	Forest Service.....	Dry kilns.....	Do.
Arlie W. Schorger....	.....do.....	Apparatus for straining crude eleoresin.	Disallowed.
Elmer Johnson and J. Clay Woodson.	Public Roads and Rural Engineering.	Fire extinguisher.....	Pending.
Wm. H. Waggaman, Harry Bryan, and Cary B. Wagner.	Soils.....	Apparatus for the manufacture of phosphoric acid and compounds of the same.	Allowed.
Otto Kress and Howard F. Weiss.	Forest Service.....	Process for producing paper pulpboard containing bark.	Disallowed.

Patents applied for by members of the department—Continued.

Applicant.	Bureau.	Invention.	Disposition of application.
Harry D. Gibbs and Geo. A. Geiger.	Chemistry.....	Process for manufacturing side chain chlorine derivatives of toluol.	Pending.
Clyde H. Teesdale....	Forest Service.....	Process for rendering lumber resistant to sap stain.	Allowed.
Martin N. Straughn..	Chemistry.....	Process for the preservation of fruit juices.	Pending.
Satoaki Ozaki.....	.....	Process for preparing a rice-food product.	Do.
Albert R. Merz and Wm. R. Ross.	Soils.....	Process for the simultaneous production of volatile acids and phosphate salts.	Do.
James E. Imrie.....	Forest Service.....	Improvement in shrinkage take-up frames for edge stacking lumber.	Do.
Harry D. Gibbs and Courtney Conover.	Chemistry.....	Process for the manufacture of phthalic anhydride, etc.	Do.
Do.....	.....do.....	Process for the manufacture of anthraquinone.	Do.
Do.....	.....do.....	.....do.....	Do.
Wm. G. Taggart.....	.....	Method of manufacturing decolorizing carbon.	Pending in interference.
Wm. W. Skinner and W. F. Baughman.	Chemistry.....	Process of manufacturing salt from its admixtures with impurities in crude brine.	Allowed.
Robert F. Gardiner...	Soils.....	Process of making a mixed phosphatic and nitrogenous fertilizer.	Pending.
Frederick T. Bioletti..	.....	Process of canning or bottling ripe olives or other pickles.	Do.
Robert F. Gardiner...	Soils.....	Process of making a mixed potash, nitrogenous, and phosphatic fertilizer.	Allowed.
Do.....	.....do.....	Process for producing a mixed potash, etc., and nitrogen fertilizer.	Do.
James P. Schroeder...	.....do.....	Processes of treating peat and muck for the preparation of fertilizer.	Do.
Elmer Johnson.....	Public Roads and Rural Engineering.	Fire-extinguisher spray nozzles.....	Pending.
Wm. V. Cruess.....	.....	Process of pickling olives.....	Allowed.
Wm. H. Waggaman, Cary R. Wagner, and Harry Bryan.	Soils.....	Process for the manufacture of phosphorus, phosphoric acid, and compounds of the same.	Pending.
Albert R. Merz.....	.....do.....	Process for rendering water-soluble the potash in cement mill dust.	Do.
Harry F. Lewis and Harry D. Gibbs.	Chemistry.....	Process for the manufacture of phenanthraquinone.	Allowed.
Wightman W. Garner and E. G. Beinhart.	Plant Industry.....	Process for preventing the development of black rot and other fungous and bacterial diseases in leaf tobacco.	Do.
Jos. A. Ambler and Harry D. Gibbs.	Chemistry.....	Process for the manufacture of aromatic sulphonic acids.	Pending.
Sidney D. Wells.....	Forest Service.....	Process of manufacturing paper pulp..	Allowed.
Harry D. Gibbs and Courtney Conover.	Chemistry.....	Process for the manufacture of phthalic anhydrides, etc.	Do.
J. A. Ambler, R. Hellbach, and H. D. Gibbs.	.....do.....	Apparatus for the manufacture of sulphonic acids of the aromatic carbons.	Pending.
H. F. Lewis and H. D. Gibbs.	.....do.....	Process for the purification of commercial anthraquinone.	Allowed.
J. A. Ambler and H. D. Gibbs.	.....do.....	Process for the manufacture of naphthalene sulphonic acids.	Pending.
Do.....	.....do.....	Process for the manufacture of benzine sulphuric acids.	Do.
Do.....	.....do.....	Process for the manufacture of toluene sulphonic acids.	Allowed.
Sherburne B. Henning.	Forest Service.....	Process for manufacturing glue.....	Pending.
G. Archie Russell....	Plant Industry.....	Tree trimming and harvesting machines.	Do.
Marion Dorset and Robert R. Henley.	Animal Industry.....	Process for the separation of blood serum.	Allowed.
Geo. R. Goergens....	Publications.....	Process for a new and useful improvement in motion-picture cameras.	Pending.
Alvin O. Lundell....	Animal Industry.....	Meat handling and inspection machine.	Pending in interference.
J. A. Newlin, L. J. Markwardt, and A. Elmendorf.	Forest Service.....	Airplane struts.....	Pending.
John K. Haywood....	Chemistry.....	Improvement in processes for manufacturing calcium arsenate.	Allowed.
J. W. McLane.....	Plant Industry.....	Process for preparing dried sweet corn.	Pending.
Courtney Conover and H. D. Gibbs.	Chemistry.....	Process for the purification of crude anhydride.	Do.
Elmer Johnson.....	Public Roads and Rural Engineering.	Improvements in powder-dusting machines.	Do.

Patents applied for by members of the department--Continued.

Applicant.	Bureau.	Invention.	Disposition of application.
J. J. Laing and C. W. Boling.	Forest Service.....	Nonconducting and waterproof composition.	Pending.
Do.....	do.....	Method of manufacturing nonconducting and waterproof compounds.	Do.
F. B. La Forge.....	Chemistry.....	Manufacture of a product suitable for use as a feed for stock.	Do.
Do.....	do.....	Process of manufacturing glucose.....	Do.
Do.....	do.....	Process of manufacturing gulonic lactone.	Do.
Do.....	do.....	New leavening agent.....	Do.
Do.....	do.....	Process of manufacturing an adhesive material.	Do.
D. S. Olson.....	Forest Service.....	Sand-spreading machine.....	Do.
Sidney D. Wells.....	do.....	Manufacture of paper pulp.....	Allowed.
Edward L. Sechrist...	Entomology.....	Septum for honeycomb.....	Pending.
Marion Dorset and Robert R. Henley.	Animal Industry.....	Process for refining defibrinated blood antitoxin.	Allowed.
C. S. Hudson.....	Chemistry.....	Process of manufacturing glucose.....	Pending.
Do.....	do.....	Process of manufacturing a leavening agent.	Do.
E. H. Siegler.....	Entomology.....	Improved insect trap.....	Do.
Robert F. Gardiner...	Soils.....	Process for the production of an available phosphoric anhydride and potash fertilizer.	Do.
Martin N. Straughn...	Chemistry.....	Process for the manufacture of preserves and jams.	Do.
J. N. Carothers and W. H. Ross.	Soils.....	Direct preparation of crystallized phosphoric acid.	Do.
Geo. R. Goergens.....	Publications.....	Panoramic camera attachment.....	Do.

Interferences were declared by the Patent Office between the applications for letters patent of three employees of this department and applications filed by outside parties. One case involved a process for preparing waterproof paving material; another a process of treating wood; and the third a method of manufacturing decolorizing carbon. In two of these cases testimony was taken and the cases otherwise prepared for final hearing. Much time and effort were spent in their preparation.

In one of the interference cases between the application of a department employee and that of an outside party, a decision unfavorable to the department employee was rendered by the examiner of interferences in the Patent Office. An appeal from this decision was taken and the case was argued before the examiners in chief, who reversed the decision of the primary examiner and rendered a decision favorable to the department employee. From this decision an appeal was taken by the losing party and the Commissioner of Patents after a hearing upon the appeal sustained the decision of the examiners in chief.

PUBLICATIONS OF THE OFFICE.

Three circulars were issued, containing the decision of the Supreme Court of the United States in *Weeks v. United States*, involving questions of practice and procedure in criminal cases under the food and drugs act; decision of the circuit court of appeals for the seventh circuit, in *Union Dairy Co. v. United States*, involving construction of the food and drugs act; and decision of the Supreme Court of the United States in *United States v. Schider*, also involving construction of that act. These circulars were published as Nos. 89, 90, and 91, respectively.

REPORT OF THE INSECTICIDE AND FUNGICIDE BOARD.

UNITED STATES DEPARTMENT OF AGRICULTURE,
INSECTICIDE AND FUNGICIDE BOARD,
Washington, D. C., October 9, 1918.

SIR: I have the honor to submit herewith a report on the work of the Insecticide and Fungicide Board for the fiscal year ended June 30, 1918.

Respectfully,

J. K. HAYWOOD,
Chairman of Board.

Hon. D. F. HOUSTON,
Secretary of Agriculture.

The insecticide act of 1910 places upon the department the responsibility of regulating the interstate shipments and importations into the United States at its various ports of entry of insecticides and fungicides and also the manufacture and sale of such products in the Territories and the District of Columbia. The importance of the food production campaign has caused the board to increase its efforts to protect the farmer, fruit grower, market gardener, and stock and poultry raiser against fraudulent, misbranded, and adulterated insecticides and fungicides, and thereby establish the confidence which tends to encourage the use of these materials by farmers in preventing and combating diseases and insect pests of their crop plants and live stock. It has been noted that there are many new insecticide and fungicide preparations on the market which are being made both by old manufacturers and new manufacturers who have entered the field. Evidently this stimulus to the industry is the normal result of the demand for insecticides and fungicides created by the campaign for greater food production.

INTERSTATE SAMPLES.

During the fiscal year the board reported to the Solicitor of the department 132 cases presenting alleged violations of law and with recommendations that the facts be transmitted to the Attorney General to institute criminal action or seizure proceedings. Disposition was made of 195 cases by correspondence with the manufacturers. These cases presented violations which were technical only, not flagrant, or cases in which the manufacturer gave reasonable and adequate explanation of his failure to conform to the provisions of the act. Action was taken to place in abeyance 726 samples, which, upon examination and test, were shown to be in compliance with the provisions of the law or were from shipments of the same goods made prior to shipments for which the manufacturer had been convicted and had after citation conformed to the requirements of the law. On June 30, 1918, 55 cases were pending preliminary hearings

or before the board for final action, 217 were held in temporary abeyance pending the receipt of further information or the outcome of prosecutions based on the same product, or correspondence with the manufacturers, and 325 samples were undergoing analysis and test.

The inspectors and sample collectors of the board, operating throughout the United States, collected 748 samples during the year. A general classification of the articles represented in the collection is as follows:

Interstate samples collected.

Class of samples.	Number of samples.	Class of samples.	Number of samples.
Arsenate of lead.....	83	Insecticide and fungicide preparations, agricultural use.....	42
Bordeaux mixture and combinations of Bordeaux mixture with insecticides...	63	Kerosene emulsions.....	5
Chlorinated lime.....	9	Lice and mite killers.....	48
Dips for animals.....	35	Lime-sulphur solution and sulphur preparations.....	46
Disinfectants, germicides, bactericides...	100	Nicotine preparations.....	17
Fly preparations, for animals.....	35	Paris green.....	33
Fish-oil and whale-oil preparations.....	19	Pyrethrum and hellebore powders.....	45
Formaldehyde preparations.....	7	Miscellaneous.....	42
Insect preparations, household use.....	119		

IMPORT SAMPLES.

During the year 31 official and unofficial import samples of insecticides and fungicides were collected by the various port laboratories of the Bureau of Chemistry for examination and test by the board. Disposition was made of 32 samples; one official sample was found misbranded, and it was recommended that the consignment be released when correctly labeled. The remaining samples were unofficial, three of them being found to be adulterated or misbranded, or both, and in these cases it was recommended that future shipments be detained, while 28 were neither adulterated nor misbranded.

PERCENTAGE OF VIOLATIONS.

The following statement dealing with official samples of certain commonly used spraying materials collected in connection with the enforcement of the law shows the progress made each year since the enactment of the law in reducing violations thereof:

Percentage of violations.

Shipped interstate, year.	Lead arsenate, paste and dry.	Paris green.	Lime-sulphur, solution and dry.	Bordeaux mixture and Bordeaux mixture combined with insecticides.
	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>
1911-12.....	60	28	94	98
1913.....	30	21	86	71
1914.....	20	19	27	49
1915.....	8	19	14	36
1916.....	32	8	25	32
1917.....	10	12	40	28

SPECIAL INVESTIGATIONS.

The investigation begun some time ago to discover a chemical method of determining stems in insect powder, determine reasonable standards for insect powder, and study the process of manufacture of insect powder and composition of raw materials as well as the finished product has been completed and the data for a report collected. The data include statistics of the insect-powder industry, early history, cultivation and harvesting of the flowers, preparation of the powder, its use as an insecticide, common methods of adulteration, and a review of the physiological and chemical methods for examining insect powder. A method has been devised for the quantitative determination of powdered stems in insect powder, which is of great importance in that it enables the board to determine whether or not the insect powder sold on the American market is adulterated with stems. Results of chemical analyses of several hundred authentic samples of insect flowers, stems, and powders are given, on the basis of which standards for allowable amounts of sand and stems in insect powder have been determined and prepared for issuance in the Service and Regulatory Announcements of the board.

A paper was published in the *Journal of Agricultural Research*, for October, 1917, entitled, "The Occurrence of Manganese in *Chrysanthemum Cinerariaefolium*." In this paper it is shown that the presence or absence of manganese in insect powder is of no value in determining its genuineness or purity, as has been claimed by previous writers, that if the plants are grown in a soil containing manganese the flowers as well as the stems will contain manganese, and that, of course, in the absence of manganese in the soil it will not be present in either the stem or flowers.

A paper prepared by a chemist of the board in collaboration with the Bureau of Chemistry, entitled, "The Decomposition of Di-Lead Arsenate by Water," was published in the *Journal of the American Chemical Society* for September, 1917. It is shown in this paper that water decomposes di-lead arsenate, with the liberation of arsenic acid. Equilibrium is reached when the concentration of the arsenic acid is very low, but if the water is constantly replaced by pure water the action proceeds until about 40 per cent of the total arsenic oxid goes into solution and the residue is converted to a basic arsenate. The results are of practical importance as showing what may take place when di-lead arsenate is applied to foliage and acted upon by rain, fog, dew, etc.

During the last two years one of the chemists of the board, in collaboration with the Bureau of Chemistry, has made investigations to determine how calcium arsenates sold in American commerce should be labeled and to obtain scientific information relative to the preparation and properties of the various calcium arsenates. The chemical work along this line is practically completed and scientific papers on the subject will be published. As a result of this work, the board was able to supply the Bureau of Chemistry with the basic information for an investigation of the preparation of calcium arsenate under commercial conditions. Also, as a result of this work, the board was able to supply the Bureau of Chemistry with basic information on which to prepare the calcium arsenates used in the project entitled.

"Chemical composition and properties of raw materials used in manufacturing; methods of preparing various arsenical insecticides and physiological effect of these compounds on insects."

On the basis of chemical, bacteriological, and entomological investigations of sweeping compounds and the constituents of the same made by the board, a "Notice to manufacturers of sweeping compounds" was published October 6, 1917, in the seventeenth Service and Regulatory Announcement of the board, warning them not to make in the labels for such products any disinfectant or insecticidal claims which were unwarranted, and further advising that it had been the almost universal experience of the board that such products were not effective in either repelling or killing certain household insects, or as disinfectants or germicides, when used as directed.

On the basis of chemical and bacteriological investigations of washing and scouring powders and the constituents of the same made by the board, a "Notice to manufactures of washing and scouring powders" was published October 6, 1917, in the seventeenth Service and Regulatory Announcement of the board, warning them that if their labels made germicidal and antiseptic claims the products must do what was claimed for them, and further advising that a considerable number of washing and scouring powders advertised as possessing germicidal or antiseptic properties had been tested by the board, and it had been found that most of them were not effective as germicides or antiseptics when used as directed.

On the basis of chemical investigations made by the chemists of the board and practical field tests made by the plant pathologists and entomologists of the board a "Notice to manufacturers of Bordeaux-lead arsenate" was issued in the twentieth Service and Regulatory Announcement of the board, June 6, 1918. In this notice manufacturers were informed relative to the faults in their Bordeaux-lead arsenate formulas, were informed of the practically universal faulty statements made on the labels of such mixtures, and were informed of the danger of using such a mixture on certain vegetation. Suggestions were made designed to correct the above faults and bring the products in conformity with law.

Working in cooperation with the Bureaus of Chemistry and Entomology the board has collaborated with the United States Food Administration in enforcing the provisions of the Food Control Act of August 10, 1917, as it applies to insecticides. Chemical advice has been given to the United States Food Administration and many data have been supplied to them relative to names and addresses of manufacturers, lists of manufacturers engaged in the manufacture of certain types of insecticides, and the importance or nonimportance of various insecticidal materials. A representative of the board has attended several conferences between the United States Food Administration and manufacturers and has been able to supply data of value. As a result of the activities of the United States Food Administration, assisted by the above-mentioned departmental agencies, the price of arsenic asked by the producer has been reduced from 12 to 16 cents to 9 cents for carload lots and $9\frac{1}{2}$ cents for shipments less than a carload. This will presumably lead to a reduction in the price of Paris green, lead arsenate, and other arsenical insecticides to the consumer.

Working in cooperation with the Bureaus of Chemistry and Entomology, the board has collaborated with the Wood Chemical Section

of the Raw Materials Division, Council of National Defense, in arranging for the substitution of vinegar for acetic acid in the manufacture of Paris green, since all acetic acid is needed by the Government in the development of its aeroplane program. The board's representative has been able to supply certain needed chemical and practical advice at various conferences between the Wood Chemical Section of the Raw Materials Division and manufacturers of Paris green. As a result of these conferences a decision was reached that no more acetic acid could be supplied for the manufacture of Paris green after July 1, 1918. It has been arranged, however, that an ample supply of vinegar will be produced for use in manufacturing Paris green.

Plant pathologists of the board working in cooperation with the Bureau of Plant Industry have continued investigations relative to the practical value of several types of fungicides concerning which reliable or conclusive data have heretofore been lacking. Additional results have been obtained relative to the efficiency of dusting mixtures for use in controlling various plant diseases. Considerable information of value to the board in connection with the enforcement of the act has been obtained by a study of the relative values of the various types of sulphur compounds, such as the sodium polysulphids and calcium polysulphids. The compilation of the results of this work with a view to publication is now under way. Valuable data were also obtained relative to the effect of combining different types of arsenicals, such as lead arsenate and calcium arsenate, on the fungicidal value and injurious properties of these sulphur compounds. An investigation comparing results with Bordeaux mixtures containing various amounts of copper has given important data concerning the amount of copper necessary in commercial Bordeaux mixtures to insure satisfactory control of certain plant diseases.

In collaboration with the Bureau of Plant Industry, material was prepared for Farmers' Bulletin 994, entitled "Commercial Bordeaux Mixtures—How to Calculate Their Values." The object of this bulletin is to aid the users of commercial Bordeaux mixtures to calculate from the composition as stated on the label, in terms of the formula by which they commonly express the strength of home-made mixtures, the amount of equivalent copper sulphate such commercial mixtures would contain when diluted for use as directed, and to give methods whereby the dilution recommended may be so changed as to produce a mixture in each case equal to the Bordeaux formula required for the purpose in question. The bulletin also discusses briefly the physical properties of Bordeaux mixtures and suggests methods of determining readily good and poor physical properties.

During the year the entomologists of the board, working in cooperation with the Bureau of Entomology, have completed the work relative to the action of a large number of chemicals on bedbugs, cockroaches, clothes moths, and carpet beetles, and publication has been made as a professional paper under the title, "Results of Experiments with Miscellaneous Substances Against Bedbugs, Cockroaches, Clothes Moths, and Carpet Beetles" (United States Department of Agriculture, Bulletin 707). This paper, the first of several to be published on the results of tests with various substances against many different insects, is of value to manufacturers, in that it gives

information relative to effective and ineffective ingredients entering into the composition of insecticides for use against certain household insects.

Also work was completed on a study of the effect of storage, heat, and moisture on the insecticidal value of pyrethrum, and a paper was submitted for publication in the *Journal of Agricultural Research* under the title, "A Study of the Effect of Storage, Heat, and Moisture on Pyrethrum."

Aside from the routine work of testing the efficacy of proprietary insecticides, the entomologists have continued the investigations relative to the practical value of a number of substances in the control of certain insects, including tobacco powders, naphthalene, pyrethrum, and sulphur. Exhaustive tests and studies were made of the practical value of the various so-called "nest eggs." A very thorough study was made on the control of chicken lice, chicken mites, and dog fleas, with a view to publication of the results. Field tests of the value of various dust mixtures were continued for the purpose of obtaining further information for use in connection with the enforcement of the insecticide act.

The board has cooperated with the Bureau of Entomology in collecting and examining a large number of proprietary preparations recommended for use against body lice and certain other vermin. This work was undertaken to determine the value of these preparations for practical use by the Army and Navy, and many of the tests were made by the Bureau of Entomology on a large scale at Army cantonments.

In cooperation with the Zoological Division of the Bureau of Animal Industry, tests were made relative to the use of soda lye as a remedy for and preventive against worms infesting hogs. As a result of these tests a "Notice to manufacturers of soda lye" was published October 6, 1917, in the seventeenth Service and Regulatory Announcement of the board, advising that statements on soda lye labels recommending its use as a worm remedy and preventive are unwarranted and should be removed.

REPORT OF THE FEDERAL HORTICULTURAL BOARD.

UNITED STATES DEPARTMENT OF AGRICULTURE,
FEDERAL HORTICULTURAL BOARD,
Washington, D. C., September 30, 1918.

SIR: I submit herewith an executive report covering the administration of the plant quarantine act for the fiscal year ending June 30, 1918.

Respectfully,

C. L. MARLATT,
Chairman of Board.

Hon. D. F. HOUSTON,
Secretary of Agriculture.

LINES OF WORK.

The principal lines of work under the plant quarantine act during the fiscal year ending June 30, 1918. are as follows: (1) The pink bollworm work, including the cotton-free zone and quarantine work in Texas, the border quarantine and disinfection service as to cars and freight from Mexico, and the research work in relation to the life history and habits and means of control of the pink bollworm conducted in cooperation with Mexico near San Pedro in the Laguna district, Mexico; (2) the regulation of the entry of foreign cotton lint, waste, cotton bagging, etc.; (3) the regulation of the entry of nursery stock and other plants and plant products for propagation; and (4) the enforcement of the miscellaneous foreign and domestic quarantine and other restrictive orders listed at the end of this report.

The personnel of the board and its principal administrative officers remain the same as last year. Owing to war conditions the board has lost many of its efficient inspectors in both local and field service. The pink bollworm work in Texas and on the border has necessitated a very extensive addition to the quarantine inspection force. Port inspection offices are maintained at Boston, New York, Newark, San Francisco, Seattle, Calexico, and all of the border ports between Mexico and Texas. The occasional needs of other border ports and of the interior ports of entry are met for the most part by State officials acting as collaborators of the board. The board has continued its cooperative relations with the State, Treasury, and Post Office Departments of the Federal Government, and with State inspection and other officials. Many of the last have been appointed collaborators of the board.

Some of the more important activities of the board are discussed in the following pages.

THE PINK BOLLWORM.

REVIEW OF WORK IN TEXAS.

The establishment in the Laguna, the principal cotton-growing district of Mexico, of a very serious enemy of cotton, the pink bollworm, an insect before unknown on the North American continent, was discussed in the report of the Federal Horticultural Board last year. There was also noted the establishment of a quarantine immediately following this discovery, in November, 1916, prohibiting the further entry of cotton or cotton seed from Mexico, and the provision for a very complete border-control service to prevent the accidental entry of such products with freight cars or other cars, or freight or baggage, entering the United States from Mexico. A special appropriation of \$50,000 by Congress made possible the institution of thoroughgoing inspection and clean-up operations with respect to the mills in Texas, which had, prior to the discovery of this insect in Mexico, received Mexican cotton seed for crushing. To secure information as to the distribution of the pink bollworm in the Laguna district and elsewhere in Mexico, as complete a survey as was possible, under the disturbed conditions obtaining in Mexico at that time, was made by experts of this department.

As reported in a footnote added to the report for last year three outbreaks of the pink bollworm were determined in Texas subsequent to the period covered in that report. Two of these undoubtedly originated from the seed received from Mexico during 1916, viz., at Hearne, reported September 12, and at Beaumont, reported October 15. The third area of infestation, reported October 21, is of uncertain origin and proved to be of much greater importance than the earlier ones, and involved a very considerable area surrounding Trinity Bay, Tex.

The clean-up operations which were instituted immediately on the discovery of each of these several points of infestation were of the most radical character and were made possible by a further emergency appropriation by Congress of \$250,000, available October 6, 1917.

With respect to these several points of infestation the one at Hearne, Tex., was very trivial and involved only a few fields of cotton in the immediate neighborhood of the oil mill at that point which had received seed from Mexico in 1916. Only a few injured bolls were found and there is every reason to believe that the infestation at this point was entirely eliminated by the destruction of all growing cotton and the clean-up of the cotton fields which was carried out over a wide radius about the mill in question—a clean-up which involved the uprooting and burning of the standing cotton, the careful collection and burning of all scattered bolls and parts of plants, the prompt milling and destruction of the seed, and the shipment to Europe of the harvested lint.

The infestation in the neighborhood of Beaumont was aggravated by the fact that the mill in this instance violated its contract in relation to seed imported prior to the quarantine of 1916; namely, to use such seed for milling only and under a strict prohibition of sale

for planting. It developed that this mill sold Mexican cotton seed to a good many planters within a range of 20 or 30 miles of the mill, with the result of infesting a large number of cotton fields. These sales were all traced and the entire surrounding district was included in the clean-up operations and subsequent State quarantine.

The infestation about Trinity Bay, Tex., developed into an alarming situation, involving upward of 6,000 acres of cotton more or less surrounding this bay. The source of the infestation about Trinity Bay has not been definitely determined, but seems to have had no relation to any importation of cotton seed from Mexico prior to the establishment of the quarantine. The infestation in this district indicates the probable presence there of the insect for three or four years. The insect may have been introduced through some importation of foreign cotton seed in violation of the Federal quarantine, or, as seems more probable, through some storm-wrecked cotton or cotton seed from Mexico. Following the great storm of 1915 cotton lint and cotton seed were observed quite generally washed up about the shores of this bay, some of which was known to be from the Laguna, Mexico. The distribution of the insect about the bay indicated in the survey of the fall and winter of 1917 bears out this theory of origin.

A large force of experts and laborers was assembled and all the infested fields about Beaumont and Trinity Bay were subjected to the same radical clean-up previously carried out at Hearne, Tex. The officials of the State Department of Agriculture of Texas co-operated heartily, to the extent of available funds, in this survey and clean-up work. A total of 8,794 acres of cotton land in the Trinity Bay and Beaumont districts was thus cleaned of standing and scattered cotton at an average cost of \$9.94 per acre. At the beginning the cost of the work was rather high, but as it progressed and the men in charge became more familiar with it, the cost per acre was considerably reduced. This cost does not include the technical supervision but merely the labor engaged in the actual clean-up, and the transportation and subsistence of this labor where such was necessary. In some cases field camps were established and maintained. The wages paid ranged from \$1 to \$2.50 per day, the majority of the men receiving \$2 per day.

An effort also was made, which was substantially successful, to collect and mill under supervision all cotton seed grown in this section, and to ship the lint cotton to foreign countries via Galveston.

Prior to the discovery of the actual presence of the pink bollworm in Texas it seemed important, to protect the United States from the risk of entry of this insect by natural migration from Mexico, that the State of Texas should enact legislation giving authority to establish a zone free from cotton culture on the border of Texas adjacent to Mexico. A conference in Washington participated in by the commissioner of agriculture of Texas and other officials, including Representatives in Congress from that State, was therefore called under the auspices of the United States Department of Agriculture in July, 1917. This conference resulted in the passage of a law by the State of Texas (Oct. 3, 1917) providing for the establishment of cotton-free zones and giving quarantine and other powers of control

in relation to any districts in Texas infested with the pink bollworm. This act, which calls for Federal cooperation, became effective 90 days after the adjournment of the State legislature. Under it the following action has been taken by proclamation of the Governor of Texas:

(1) A pink bollworm quarantine was instituted January 21, 1918, placing under quarantine as to the cotton crop the two infested areas in Texas and providing for the clean-up of the infested fields and the disposition of the crop in such a manner as to afford adequate protection to the cotton industry of Texas. These quarantined zones are (No. 1) an area 6 miles in diameter surrounding the oil mill at Hearne, Tex., and (No. 2) the Trinity Bay and Beaumont districts, including the counties of Chambers, Jefferson, Galveston (except the island of Galveston), and portions of Brazoria, Fort Bend, Harris, Liberty, and Hardin counties. To this district was afterward added a small section, including Arcola as a center, extending to the Brazos River, by a proclamation of February 25, 1918. This extension was based on the finding of a single specimen in a field near Arcola. Inasmuch as this is merely a completion of quarantine district No. 2, the whole Trinity Bay region is referred to in this report as district No. 2.

(2) A border noncotton zone to include the counties of Kinney, Maverick, and Valverde was established February 18, 1918. This action was based on the determination of infestation of cotton lands in Mexico nearly opposite Eagle Pass, within 25 miles of the Texas border. The growth or transportation of cotton or any cotton product from said counties is forbidden for three years.

(3) A proclamation of noncotton zones was issued February 25, 1918, prohibiting after that date the growth of cotton in the districts above described for a term of three years, or so long as the pink bollworm menace to the cotton industry of Texas should exist.

This action has entailed a certain amount of loss and hardship to many planters within the quarantined and proclaimed cotton-free areas, in that it has eliminated what has been the principal money-producing crop. Fortunately in the principal district involved, the Trinity Bay region, cotton has not hitherto been the principal crop of the district, although one of large importance, especially in favorable years.

Some opposition developed to the quarantine and to the establishment of noncotton areas, but it is gratifying to report that the majority of the planters realized the need and the national aspect of the emergency and gave their full and hearty cooperation to the law. Complete cooperation was had in noncotton zone No. 1, involving the Hearne district, and in the border zone.

A very small percentage of the planters included in the quarantined district about Trinity Bay and Beaumont (noncotton zone No. 2), misled by a few interested parties, were induced to plant cotton in violation of the quarantine. About one-half of the cotton thus planted was, however, afterwards plowed out. Fully 95 per cent of the planters in this zone complied with the proclamation of the governor prohibiting the growth of cotton and cooperated fully in the subsequent clean-up operations with respect to volunteer cotton maintained in this district during the summer of 1918.

The extent of this cooperation is indicated by the fact that probably 50,000 acres of cotton would normally have been planted in

zone No. 2, whereas the cotton which was permitted to come to maturity in this district amounted to only 1,789 acres, involving the plantings of 137 individuals. Legal action has been taken by the State of Texas with respect to this unlawfully planted cotton, but, although the law has been sustained, the delay has been such that the crop from this planting has now been matured and is being harvested. This has produced a condition in which the State is faced with the necessity of safeguarding a crop of approximately 800 bales of cotton illegally grown. Rather than enforce the destruction of this cotton, it seemed desirable to effect a compromise, which would leave it available for use and yet so safeguarded in its harvesting and disposition as to reduce the risk probably as much as would its actual destruction at this time. A willingness on the part of the planters concerned to enter into such an arrangement has developed, and the compromised plan is now being put into effect. This compromise involves complete control by the State of the crop produced, and its harvesting and clean-up under the same radical methods followed with last year's crop. It further involves the assumption by the planters of the total cost of the necessary clean-up and their entering into an agreement not to plant or grow cotton in violation of any quarantine on account of the pink bollworm in the State for the term of such quarantine. This department has cooperated in securing this action and will aid in the carrying out of these provisions.

Throughout the summer all of the quarantined districts in Texas have been under inspection, and all volunteer or seedling cotton has been destroyed. The only growing cotton left is in the illegally planted fields in zone No. 2. Fortunately these fields are in parts of the quarantined area which were very sparsely or not at all infested last year, and the clean-up of old cotton and the destruction of the larvæ hibernating in old bolls in these districts, as elsewhere throughout the quarantined areas, was so thoroughly done during the fall and winter of 1917-18 that the likelihood of infestation this year has been reduced to a minimum.

The most encouraging feature of the year's work is the fact that not a single pink bollworm egg, larva, or moth has been found within either of the quarantined areas during the season of 1918, or elsewhere in Texas. This would seem to indicate the efficiency of the clean-up of last year of these districts, and gives very large ground of expectation for the ultimate complete extermination of the pink bollworm in Texas. If this result is achieved it will be the largest successful entomological experiment of the kind in history.

Field surveys are being conducted adjacent to the quarantined districts to determine any possible spread beyond the existing quarantine lines. Similar surveys are being continued also with respect to all the mills in Texas, which, prior to the discovery of the pink bollworm in Mexico, had received cotton seed from that country. Furthermore, all cotton seed and lint which had been imported from Mexico during 1915-16 has been traced to ultimate destination, and in all southern districts where such material has gone an inspection of adjacent cotton fields has been made. No infestations by the pink bollworm, other than those already determined in Texas, have been found anywhere in the United States as a result of these investigations.

The only adverse feature, therefore, is the cotton unlawfully planted in zone No. 2 in Texas. Responsibility for possible failure to exterminate the pink bollworm in Texas, should such failure ultimately result, must rest upon the comparatively few interested parties who have been responsible for misleading a number of farmers and encouraging them thus to violate the Texas statute. The individuals who have thus planted cotton in violation of the law are known, as also the acreage planted and the probable amount of the crop produced, and, under the State law, they must bear the expense of cleaning and disinfecting the cotton in such manner as the commissioner of agriculture of the State shall direct.

TEXAS BORDER QUARANTINE SERVICE.

The regulation of the entry into the United States of railway cars and other vehicles, freight, express, baggage, and other materials from Mexico and the inspection, cleaning, and disinfection of such cars and freight, etc., have been continued during the year to prevent the accidental movement of cotton and cottonseed from Mexico into the United States. This inspection service covers the ports of El Paso, Del Rio, Eagle Pass, Laredo, and Brownsville, and now involves the services of 11 inspectors. During the year 25,257 cars have been inspected and passed for entrance into the United States, divided among the border ports as follows: Brownsville, 1,635; Eagle Pass, 3,836; El Paso, 6,787; Laredo, 12,999.

No cars or freight fouled with cotton seed are permitted entry until such seed has been entirely removed. This necessitates, in many cases, the transfer of freight to clean cars on the Mexican side. In addition, as a condition of entry, all cars and freight which come to the border containing such seed are disinfected with hydrocyanic-acid gas. At the beginning of this work this disinfection was only given to cars or freight which had either been found to contain cotton seed or which had originated in regions where the pink bollworm was known to be present. The general presence of cotton seed in cars and freight later necessitated the fumigation of practically all cars and freight entering from Mexico, with the exception of certain cars concerned in the shipment of ore and lumber chiefly offered for entry at the port of El Paso, and which, under arrangement with the importing companies, were thoroughly cleaned of cotton seed at point of origin before loading and so certified.

The system of disinfection of cars and freight with hydrocyanic-acid gas by means of generators placed within the cars has been the best available means, but is unsatisfactory owing to the poor condition of the cars and also to the fact that it gave no security against any insects which might be resting on the exterior of the cars or their motive parts. To meet these defects it seemed highly desirable to provide for the disinfection of cars and freight in specially constructed houses capable of containing one or more cars at a time.

The erection of such fumigation houses was authorized toward the end of the fiscal year 1917-18, and plans were drawn, bids secured, and contracts let for the construction of five fumigation houses at the ports above mentioned. The construction of these houses is now well under way. Their size has been adjusted to the needs of the

traffic, and they have the following car capacity at the different ports of entry: Laredo, 15 cars; Eagle Pass, 8 cars; Brownsville, 6 cars; and El Paso, 1 car. At Del Rio no railroad line crosses the border, and a house is being constructed to take care of traffic in wagons and motor trucks. Each of these houses is provided with a system of generators in which hydrocyanic-acid gas is produced and distributed to the house.

The cost of this disinfection will be assumed by the Department of Agriculture and a charge will be made to cover the actual labor, other than supervision, and the chemicals used. The moneys so received, under the law, must be turned into the Treasury of the United States. This will result in a very considerable depletion of the funds available for this border quarantine service, and it will, therefore, probably be necessary to ask Congress to reimburse the fund thus expended. These houses will probably be completed and in use by the end of October, 1918, and will add very much to the efficiency of the border quarantine service.

THE SITUATION IN MEXICO.

The pink bollworm situation in Mexico, as determined by surveys conducted during the last two years, seems to confirm the limitation of the pink bollworm infestation to the Laguna district and to two other isolated areas of small extent opposite Eagle Pass, Tex. This situation indicates a much more favorable outlook for possible future extermination of the insect in Mexico than had been anticipated. The Mexican Government issued a decree on November 15, 1917, restricting transportation from the Laguna district of cotton or cotton seed to other parts of Mexico, and preliminary arrangements have been made in cooperation with the Mexican Government and the planters concerned, which may ultimately lead to the prohibition of the growth of cotton in the Laguna and in the other infested districts for a series of years and the substitution therefor of other crops.

The experiment station to study the pink bollworm and to conduct field experiments with the growth of crops in substitution for cotton established last year in the Laguna district by this department has enabled us to secure much needed information relating to the habits and food plants of the insect. This information may be of great future service in determining the most efficient means of preventing spread and maintaining field control. As to substitute crops, the wheat and corn crops of the Laguna this year have been extraordinarily successful, and the peanut and castor-bean crops have given good promise.

PROVISIONS FOR PINK BOLLWORM WORK FOR THE FISCAL YEAR 1919.

To provide for the continuation of the pink bollworm work, the Secretary of Agriculture submitted to Congress an estimate for a special appropriation of \$800,000, to be included in the Agricultural appropriation bill for the fiscal year 1919.¹ The House and Senate ultimately approved an appropriation for this purpose of \$500,000. The items of work provided for under this appropriation are as follows:

(1) To prevent the movement of cotton and cotton seed from Mexico into the United States, including the regulation of the entry into the United States of

¹Approved October 1, 1918.

railway cars and other vehicles, and freight, express, baggage, or other materials from Mexico, and the inspection, cleaning, and disinfection thereof, \$50,000.

(2) To make surveys to determine the actual distribution of the pink bollworm in Mexico and to exterminate local infestations in Mexico near the border of the United States, in cooperation with the Mexican Government or local Mexican authorities, \$25,000.

(3) To investigate in Mexico or elsewhere the pink bollworm as a basis for control measures, \$25,000.

(4) To conduct surveys and inspections in Texas or in any other State to detect any infestation and to conduct such control measures, including the establishment of cotton-free areas, in cooperation with the State of Texas or other States concerned, as may be necessary to stamp out such infestation, to establish in cooperation with the States concerned a zone or zones free from cotton culture on or near the border of any State or States adjacent to Mexico, and to cooperate with the Mexican Government or local Mexican authorities, or otherwise, by undertaking in Mexico such measures for the extermination of the pink bollworm of cotton as shall be determined to be practicable from surveys showing its distribution, \$400,000.

The bulk of the appropriation falls under the fourth item and is essentially an insurance fund to cover such clean-up work in relation to the crop of 1918 as was conducted in the infested cotton areas of Texas with relation to the crop of 1917. It also includes the Federal cooperation with respect to quarantined areas and border cotton-free zones in Texas and other States adjacent to Mexico, and similar cooperative work with Mexico.

COTTON IMPORTATIONS.

The restrictions placed on the entry of foreign raw cotton are to prevent the entry of the pink bollworm and other dangerous cotton insect pests with the seed that is contained in greater or less amount in all such cotton.

The rules and regulations governing the importation of cotton into the United States were revised, effective August 1, 1917, the revision incorporating the amendments that had been promulgated since the issuance of the regulations as revised January 25, 1916, and several other changes. For the convenience of permittees and licensees a compilation and revision was also made of the numerous circular letters of instruction and explanation issued by the board since the promulgation of the original cotton regulations. This compilation was issued in pamphlet form in April, 1918.

The revised regulations leave it optional with the board whether the screening of mills in which disinfected foreign cotton is used, or of warehouses in which such cotton is stored, shall be required. The method of disinfection now in force at northern ports is believed to be normally thoroughly effective. The board has, therefore, removed the screening requirements for all northern mills and warehouses. In the case of cotton mills located in or near the cotton belt, the screening of all storage houses and other places in which foreign cotton is kept, and of rooms in which it is handled and cleaned prior to the carding process, will be continued, as an additional safeguard.

Early in the calendar year 1918 two vacuum fumigation plants were established at Seattle, Wash. Cotton and such cotton waste and burlap as require disinfection may, therefore, now be entered at the ports of Boston, New York, Newark, San Francisco, and Seattle, at all of which ports facilities are available for the

disinfection of the above-mentioned material. Card strips and other grades of cotton waste resulting from and subsequent to the carding machine, if covered with wrappings which conform to the requirements of the cotton regulations, and bagging which has never been used to cover cotton, or American cotton bagging, commonly known as coarse gunny, which has been used to cover only cotton grown in the United States, may be admitted without disinfection at any port at which the board maintains inspection service, including, in addition to the ports mentioned above, Philadelphia and New Orleans.

In the latter part of the fiscal year 1917 the inspector of the board at San Francisco discovered that articles from Japan packed with a low grade of cotton waste containing seeds were being imported through that port. Investigations by inspectors at other ports developed the fact that Japanese and Chinese bric-a-brac, chinaware, crockery, etc., were frequently packed with cotton or cotton waste. The Secretary of State was requested to warn Japanese and Chinese exporters, through the Consular Service, to use packing other than cotton or cotton waste for goods intended for the United States. The board also secured the names of the American importers of such merchandise in this country, and these were requested to instruct their foreign exporters to discontinue the use of such packing for goods consigned to this country. Arrangements have been made with the Treasury Department for the notification of the board by collectors of customs upon the entry from any country of any articles for which cotton waste is used as packing.

All permits for the importation of cotton and all licenses authorizing the use of cotton, issued since July 1, 1916, are valid until revoked. In addition to the permits and licenses issued during the fiscal year ending June 30, 1917, which are still effective, 501 new cotton permits and 119 new cotton licenses were issued by the board during the past fiscal year.

The following table indicates the number of bales of cotton, cotton waste, and burlap imported during the fiscal year, showing country of origin and port of entry:

*Cotton, cotton waste, and burlap imported from July 1, 1917, to June 30, 1918,
in running bales, showing country of origin and port of entry.*

[illegible]

Cotton, cotton waste, and burlap imported from July 1, 1917, to June 30, 1918, in running bales, showing country of origin and port of entry—Continued.

Country of origin.	New York.			Boston.			Philadelphia.			San Francisco.		
	Raw cotton.	Cotton waste.	Bur-lap.	Raw cotton.	Cotton waste.	Bur-lap.	Raw cotton.	Cotton waste.	Bur-lap.	Raw cotton.	Cotton waste.	Bur-lap.
Nicaragua.....	124											
Panama.....			12									
Peru.....	31,627			100								
Portugal.....			153									
Salvador.....	7									6		
Scotland.....			385			197			378			
Spain.....			1,001									
United States....	31			90								
Venezuela.....		30										
Total.....	53,849	6,625	22,187	68,446	1,769	13,713		479	7,862	29,612	205	720

Country of origin.	Seattle.			All other ports.			Total.		
	Raw cotton.	Cotton waste.	Bur-lap.	Raw cotton.	Cotton waste.	Bur-lap.	Raw cotton.	Cotton waste.	Bur-lap.
Brazil.....							1,125		
Canada.....					7	100		1,157	1,060
China.....	6,071	43		2			45,144	203	
Colombia.....							314		
Denmark.....								201	594
Dominican Republic.....							181		
Ecuador.....							585		
Egypt.....				750			66,182		
England.....								941	26,252
France.....								644	13,438
Haiti.....							5,720		
Holland.....									259
India.....	1,000						8,494		
Italy.....								403	
Japan.....		328						5,437	853
Mexico.....				135,986			35,986	435	
Nicaragua.....							124		
Panama.....									12
Peru.....							31,727		
Portugal.....									153
Salvador.....							13		
Scotland.....									960
Spain.....									1,001
United States....		6		7			128	6	
Venezuela.....								30	
Total.....	7,071	377		36,745	7	100	195,723	9,462	44,582

¹ Entered at port of Calexico.

In addition to the cotton shown in the table, 196 packages of samples of cotton and cotton waste were imported during the fiscal year.

While a comparison of the above table with the importations shown on the board's report for the fiscal year 1916-17 indicates a considerable falling off of importations of Egyptian cotton, due no doubt largely to the shortage of available tonnage, it shows also a marked increase in importations from practically all other countries shipping cotton to the United States.

NURSERY STOCK IMPORTATIONS.

PROPOSED ADDITIONAL RESTRICTIONS.

The need of additional restrictions or prohibitions, particularly with respect to the entry of certain classes of nursery stock and other plants and seeds on account of exceptional risks involved, has been

under consideration by the Federal Horticultural Board for some time. This consideration has had relation particularly to (1) plants imported with earth about the roots or "balled" plants and (2) plants and seeds of all kinds for propagation from little-known or little-explored countries. The large risk from importations of these two classes of plants comes from the impossibility of properly inspecting plants with earth or of disinfecting the attached earth; and from the dangers which can not be foreseen with respect to plants coming from regions where plant enemies—insect and disease—have been studied very meagerly or not at all. Inspection of such material is necessarily in the blind, and the discovery of infesting insects, particularly if hidden in bark or wood, or of evidence of disease, is largely a matter of chance. The inspection and disinfection of both of these classes of plants as a condition of entry, therefore, is a very imperfect safeguard.

There has further developed throughout the country a wide interest in this subject, which has manifested itself in numerous requests for greater restriction on plant imports from official bodies representing the State departments of agriculture, the inspection officials of the States, entomological and phytopathological associations, forestry associations, etc.

As a basis for such needed additional quarantine restrictions a public hearing was conducted at this department May 28, 1918, at which the whole subject was fully discussed with all of the interests concerned, including, in addition to those enumerated, both the importing nurserymen and seedsmen, as well as the producing nurserymen of the United States.

There have been no changes in the list of foreign countries providing for inspection of nursery stock during the past fiscal year. A full list of such countries was contained in the report for 1917.

COUNTRY OF ORIGIN AND NATURE OF NURSERY-STOCK IMPORTATIONS.

The following table gives the country of origin and the classes of plants and seeds imported during the year ending June 30, 1918.

Country of origin and nature of nursery-stock importations.

Country of origin.	Fruit trees.	Fruit-tree stocks.	Grape-vines.	Bush fruits.	Roses.	Rose stock.	Forest and ornamental deciduous trees.	Ornamental deciduous shrubs.
Australia.....				400				
Canada.....					400			
Cuba.....								65,905
England.....	4,117		186	35	88,626	1,637,900	45	23,325
France.....	3,444,697	6,310,750		500	165,014	1,344,067	858,829	1,560,221
Holland.....	6,482		555		736,185	226,527	49,873	357,290
Ireland.....					62,595	206,524		
Japan.....	60,187					100,010	62,680	25,294
Philippine Islands.....							6	
Scotland.....	282		86		3,683	78,000		148
Total.....	3,515,765	6,310,750	827	935	1,056,503	3,593,028	980,118	2,032,183

Country of origin and nature of nursery-stock importations.—Continued.

Country of origin.	Coniferous trees other than pines.	Pines.	Ever-green trees.	Ever-green shrubs.	Field-grown florists' stock.	Stocks, cuttings, or seedlings.	Tree seeds, pounds.
Australia.....							7,188
Bermuda.....	250		8,957		16,275		1,277
Brazil.....					11,001		35,214
Canada.....	4		1	100	1,258	25,700	
Canal Zone.....					600		
Colombia.....					27,623		
Costa Rica.....					298		
Cuba.....			160	13	1,093		
Dutch Guiana.....					25		
England.....	7,392		2,647	68,999	23,627		
France.....	239,766		34,739	139,212	126,660	2,543,218	
Guatemala.....					100		
Holland.....	43,640		3,353	187,117	365,139	40,723	
India.....					25		
Italy.....							3
Japan.....	7,233	1,958	387	3,213	12,275	54,227	8,291
Leeward Island (Antigua).....							21
New South Wales.....							23,500
New Zealand.....					3	84	
Panama.....					400		
Philippine Islands.....					1,720		7
Salvador.....				200			
Samoa.....					14		
Scotland.....	121		14	300	191		
Spanish Honduras.....					28		
Trinidad.....					6,997		781
Venezuela.....					17,600		
Total.....	298,406	1,958	50,258	399,154	613,552	2,663,952	76,290

DISTRIBUTION OF IMPORTED NURSERY STOCK, BY STATES.

The following table indicates the distribution by States of nursery stock imported during the past five years:

Distribution of imported nursery stock, by States.

State.	Number of cases.				
	1917-18	1916-17	1915-16	1914-15	1913-14
Alabama.....	69	173	284	241	125
Arizona.....					4
Arkansas.....	2	26	22	95	11
California.....	995	4,891	2,403	3,357	1,229
Colorado.....	11	162	152	150	152
Connecticut.....	413	801	1,072	1,372	1,432
Delaware.....	1	51	53	40	38
District of Columbia.....	44	422	491	549	562
Florida.....	19	200	1,466	2,461	56
Georgia.....	96	223	191	228	196
Hawaii.....	10	79	57	20	4
Idaho.....		6	4	5	9
Illinois.....	473	2,891	4,671	3,316	3,942
Indiana.....	89	464	577	569	545
Iowa.....	398	731	905	1,066	394
Kansas (north).....	15	105	55	51	48
Kansas (south).....	133	96	292	292	286
Kentucky.....	77	188	410	320	352
Louisiana.....	89	228	279	400	416
Maine.....		53	65	42	51
Maryland.....	154	308	595	756	553
Massachusetts.....	662	2,112	4,769	4,221	5,115
Michigan.....	323	910	1,325	1,562	1,232
Minnesota.....	91	300	746	701	528
Mississippi.....	17	40	21	23	35
Missouri.....	68	380	513	592	676
Montana.....		36	32	20	26
Nebraska.....	61	151	249	217	149
Nevada.....				1	2

Distribution of imported nursery stock, by States—Continued.

State.	Number of cases.				
	1917-18	1916-17	1915-16	1914-15	1913-14
New Hampshire.....	2	40	44	53	57
New Jersey.....	2,369	6,860	13,295	8,829	10,458
New Mexico.....					1
New York.....	3,937	8,058	16,325	12,669	12,363
North Carolina.....	23	70	121	80	162
North Dakota.....	1	20	56	12	8
Ohio.....	1,127	2,447	3,314	3,374	3,068
Oklahoma.....	3	14	17	15	13
Oregon.....	44	326	355	480	560
Pennsylvania.....	1,282	3,638	6,096	6,556	9,309
Rhode Island.....	33	212	562	741	606
South Carolina.....	6	25	41	39	41
South Dakota.....	7	19	29	16	16
Tennessee.....	70	161	185	197	200
Texas.....	110	183	151	139	184
Utah.....		19	25	27	35
Vermont.....	1	17	41	24	20
Virginia.....	18	273	379	354	338
Washington.....	74	388	421	403	482
West Virginia.....		129	87	87	102
Wisconsin.....	78	429	509	430	334
Total.....	13,495	39,358	64,652	57,192	57,225

STATE AND FEDERAL INSPECTION OF IMPORTED PLANTS AND PLANT PRODUCTS.

As the result of State and Federal inspection of imported nursery stock and other imported plants and plant products during the fiscal year, some 280 different species of insects were intercepted, including seven nests of the brown-tail moth and three egg masses of the gipsy moth from France; six pupæ of the sorrel cutworm on miscellaneous stock from France, and one on azaleas from Belgium; larvæ of the gold-tail moth on rhododendrons, laburnums, roses, and Japanese maples from Holland and on *Cerasus avium* from France; the lesser bulb fly in bulbs from Holland, nests of the fruit-tree pierid in six shipments of deciduous fruit-tree seedlings from France, numerous scale insects and ants from various quarters of the globe. One shipment of cotton seed, infested with the pink bollworm, from Natal do Norte, Brazil, arrived at New York in violation of Quarantine Notice No. 8, and, as a result, was returned to the port of origin.

During the same period, 218 plant diseases were intercepted and identified on imported material. These organisms occurred on 115 different host plants. Three attempts were made to import, respectively, grapefruit, mandarin orange, and round orange, found to be affected with citrus canker. All were from the vicinity of Canton, China. With respect to the assurance by nurserymen that apple stocks from France are very free from crown gall, it is interesting to note that every tree of a shipment of 1,009 apple stocks received by the United States Department of Agriculture from France was rejected because it was affected with a hairy root form of crown gall.

INSPECTION AT PLANT INTRODUCTION GARDENS.

A very important part of the Federal inspection work has relation to the plant introduction gardens maintained by the Department of Agriculture at Yarrow, Md., Miami and Brownsville, Fla., and Chico,

Cal. All plant material shipped from these stations was examined during the year or at the time of shipment to eliminate the possibility of dissemination of noxious insects or plant diseases.

PLANT QUARANTINES.

The foreign and domestic quarantines and other restrictive orders now being enforced under the plant quarantine act are listed at the end of this report. Of these the following have been promulgated or revised during the year:

Domestic.—The sweet-potato and yam quarantine, the banana plant quarantine, and the gipsy moth and brown-tail moth quarantine (a revision).

Foreign.—The sweet-potato and yam quarantine, and the banana plant quarantine.

The sweet-potato and yam quarantine prohibits the further entry of sweet potatoes and yams from all foreign countries and from the Territories of Hawaii and Porto Rico, effective January 1, 1918. Promulgation of this quarantine was based on the risk which developed of entry of a new and important sweet-potato pest, the so-called sweet-potato scarabee (*Euscepes batatae*), which has a fairly wide distribution in the West Indian Islands and in South America and also in certain trans-Pacific islands and countries. The quarantine is also aimed at the sweet-potato weevils, one of which has already got firm foothold in this country and is now being made the subject of an effort at extermination. The only means of excluding these insects is to prohibit the entry of sweet potatoes and yams, inasmuch as the larvæ of these insects may be entirely hidden within the tubers and beyond the reach of disinfectants. The total importations of sweet potatoes and yams affected by this quarantine is inconsiderable.

The quarantine prohibiting the entry of banana plants from foreign countries and from the Territories of Hawaii and Porto Rico, effective April 1, 1918, is directed particularly at the banana root borer (*Cosmopolites sordidus* Germar), known to have a fairly wide distribution throughout the tropical regions of both hemispheres. This borer may be readily transported in shipments of banana plants and has been the cause of extensive loss to plantations in countries where it is established. This insect was discovered in Florida this year, evidently a recent importation affecting comparatively few plantations. Radical measures were undertaken by the State in cooperation with this department to effect its extermination, so that the banana industry which may hereafter develop in Florida or elsewhere may be safeguarded from this source of loss. No important commercial interests are affected by this quarantine.

The gipsy moth and the brown-tail moth quarantine, effective June 1, 1918, represents merely the annual revision of this quarantine which has been in effect since November 25, 1912, to take account of necessary changes in distribution. The changes necessary this year were comparatively unimportant.

COOPERATIVE WORK.

The board has cooperated during the year in the inspection and clean-up work with relation to the newly imported banana weevil in

Florida, the Japanese beetle in New Jersey, the European corn borer in Massachusetts, the oriental peach moth in eastern United States, and in the campaign to secure the eradication of the common barberry throughout the upper Mississippi Valley.

The board has further cooperated with the Bureau of Entomology in the enforcement of the moth quarantine affecting portions of the New England States, and in the Mediterranean fruit fly and melon fly quarantine in Hawaii. In respect to these two quarantines the board has supervision of the enforcement of the quarantines, which are supported, however, by special appropriations assigned to the Bureau of Entomology.

TERMINAL INSPECTION OF INTERSTATE MAIL SHIPMENTS OF PLANTS AND PLANT PRODUCTS.

During the year the State of Washington availed itself of the provisions of the act of March 4, 1915, by providing for terminal inspection of mail shipments of plants and plant products originating in other States. California, the first State to make provision for such inspection in 1915, was followed in 1916 by Arizona and Montana, and in 1917 by Florida. All plants and plant products shipped to these five States under the certification of the Federal Horticultural Board are exempted from such inspection.

VIOLATIONS OF THE PLANT QUARANTINE ACT.

During the year the Solicitor reported to this office the conviction of two shippers and two common carriers for the shipment, interstate, without inspection and certification, of plants and plant products from the area quarantined on account of the gipsy moth and the brown-tail moth to points outside of that area. Fines aggregating \$95 were imposed.

POTATO WART IN THE UNITED STATES.

In September of this year, subsequent to the period covered in this report but prior to its publication, several well-established cases of the wart disease of the potato were discovered in gardens in 26 small mining towns in Luzerne, Schuylkill, and Carbon Counties in eastern Pennsylvania. The full extent of the infestation has not yet been determined, but an active survey of this and other districts is now under way in cooperation with the authorities of the State of Pennsylvania. In most of these gardens it has been observed by the owners during the last two seasons. In many gardens it has been severe for three years, while in a few instances it has done considerable damage for four years.

The source of the disease appears to be a shipment of several carloads of European potatoes of inferior quality, distributed in 1912, before the passage of the plant quarantine act of August 20 of that year. This act specifically provided for an immediate quarantine against countries infested with the potato wart, and subsequent to the passage of this act, no importations of potatoes have been made from countries where potato wart is known to exist.

The infested area is more or less isolated, and the growth of potatoes is in gardens for local use. There is no commercial growth of potatoes in the district and therefore little likelihood of any commercial or other shipments of potatoes out of the district.

Under the leadership of Economic Zoologist J. G. Sanders the Pennsylvania State authorities are taking necessary restrictive measures to prevent infected material from moving out of the district.

It is rather to be feared that other shipments of European potatoes, made prior to the quarantine, have carried the disease to other districts, and a country-wide examination of gardens of industrial and mining villages, which were the principal markets for cheap foreign potatoes, is being made. This disease has certainly not developed in any of the important potato-producing sections of this country.

LIST OF CURRENT QUARANTINE AND OTHER RESTRICTIVE ORDERS.

QUARANTINE ORDERS.

The numbers assigned to these quarantines indicate merely the chronological order of issuance of both domestic and foreign quarantines in one numerical series. The quarantine numbers missing in this list are quarantines which have either been superseded or revoked. For convenience of reference these quarantines are here classified as domestic and foreign.

DOMESTIC QUARANTINES.

Date palms.—Quarantine No. 6: Regulates the interstate movement of date palms or date-palm offshoots from Riverside County, Cal., east of the San Bernardino meridian; Imperial County, Cal., Yuma, Maricopa, and Pinal Counties, Ariz., and Webb County, Tex.; on account of the *Parlatoria* scale (*Parlatoria blanchardi*) and the *Phoenicococcus* scale (*Phoenicococcus marlatti*).

Cotton seed and cottonseed hulls.—Quarantine No. 9: Prohibits the importation of cotton seed and cottonseed hulls from the Territory of Hawaii on account of the pink bollworm.

Hawaiian fruits.—Quarantine No. 13, revised: Prohibits or regulates the importation from Hawaii of all fruits and vegetables, in the natural or raw state, on account of the Mediterranean fruit fly and the melon fly.

Sugar cane.—Quarantine No. 16: Prohibits the importation from Hawaii and Porto Rico of living canes of sugar cane or cutting or parts thereof, on account of certain injurious insects and fungus diseases.

Cotton.—Quarantine No. 23, revised: Regulates the movement of cotton from Hawaii to the continental United States, on account of the pink bollworm.

Gipsy moth and brown-tail moth.—Quarantine No. 27: Regulates the movement interstate to any point outside of the quarantined towns and territory, or from points in the generally infested area to points in the lightly infested area, of stone or quarry products, and of the plants and plant products listed therein. This quarantine covers portions of the New England States.

Five-leaved pines, Ribes, and Grossularia.—Quarantine No. 26: Prohibits the interstate movement of five-leaved pines, currant and gooseberry plants from all States east of and including the States of Minnesota, Iowa, Missouri, Arkansas, and Louisiana to points outside of this area; prohibits further, the interstate movement of five-leaved pines and black-currant plants to points outside the area comprising the States of Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, and New York on account of the white-pine blister rust.

Sweet potato and yam.—Quarantine No. 30: Prohibits the movement from the Territories of Hawaii and Porto Rico into or through any other Territory, State, or District of the United States of all varieties of sweet potatoes and yams (*Ipomoea batatas* and *Dioscorea* spp.) regardless of the use for which the same are intended, on account of the sweet-potato weevil (*Cylas formicarius*) and the sweet-potato scarabee (*Euscepes batatae*).

Banana plants.—Quarantine No. 32: Prohibits the movement from the Territories of Hawaii and Porto Rico into or through any other Territory, State, or District of the United States of any species or variety of banana plants (*Musa* spp.), regardless of the use for which the same are intended, on account of two injurious weevils, *Rhabdocnemis obscurus* and *Metamasius hemipterus*.

FOREIGN QUARANTINES.

Irish potato.—Quarantine No. 3: Prohibits the importation of the common or Irish potato from Newfoundland; the islands of St. Pierre and Miquelon; Great Britain, including England, Scotland, Wales, and Ireland; Germany; and Austria-Hungary, on account of the disease known as potato wart.

Mexican fruits.—Quarantine No. 5, as amended: Prohibits the importation of oranges, sweet limes, grapefruit, mangoes, achras sapotes, peaches, guavas, and plums from the Republic of Mexico, on account of the Mexican fruit fly.

Five-leaved pines, Ribes, and Grossularia.—Quarantine No. 7, as amended: Prohibits the importation from each and every country of Europe and Asia, and from the Dominion of Canada and Newfoundland, of all five-leaved pines and all species and varieties of the genera *Ribes* and *Grossularia*, on account of the white-pine blister rust.

Cotton seed and cottonseed hulls.—Quarantine No. 8, as amended: Prohibits the importation from any foreign locality and country, excepting only the locality of the Imperial Valley, in the State of Lower California, Mexico, of cotton seed (including seed cotton) of all species and varieties, and cottonseed hulls, on account of the pink bollworm. Cotton and cotton seed from the Imperial Valley may be entered under permit and regulation.

Seeds of avocado or alligator pear.—Quarantine No. 12; Prohibits the importation from Mexico and the countries of Central America of the seeds of the avocado or alligator pear, on account of the avocado weevil.

Sugar cane.—Quarantine No. 15: Prohibits the importation from all foreign countries of living canes of sugar cane or cuttings or parts thereof, on account of certain injurious insects and fungus diseases. There are no restrictions on the entry of such materials into Hawaii and Porto Rico.

Citrus nursery stock.—Quarantine No. 19: Prohibits the importation from all foreign localities and countries of all citrus nursery stock, including buds, scions, and seeds, on account of the citrus canker and other dangerous citrus diseases. The term "citrus," as used in this quarantine, includes all plants belonging to the subfamily or tribe *Citrata*.

European pines.—Quarantine No. 20: Prohibits, on account of the European pine-shoot moth (*Eretria buoliana*), the importation from all European countries and localities of all pines not already excluded by Quarantine No. 7.

Indian corn or maize and related plants.—Quarantine No. 24, as amended: Prohibits the importation from southeastern Asia (including India, Siam, Indo-China, and China), Malayan Archipelago, Australia, New Zealand, Oceania, Philippine Islands, Formosa, Japan, and adjacent islands, in the raw or unmanufactured state, of seed and all other portions of Indian corn or maize (*Zea mays* L.), and the closely related plants, including all species of Teosinte (*Euchlaena*), Job's tears (*Croix*), *Polytoca*, *Chionachne*, and *Sclerachne*, on account of the downy mildews and *Physoderma* diseases of Indian corn, except that Indian corn or maize may be imported on compliance with the conditions prescribed in the regulations of the Secretary of Agriculture.

Citrus fruit.—Quarantine No. 28: Prohibits the importation from eastern and southeastern Asia (including India, Siam, Indo-China, and China), the Malayan Archipelago, the Philippine Islands, Oceania (except Australia, Tasmania, and New Zealand), Japan (including Formosa and other islands adjacent to Japan), and the Union of South Africa, of all species and varieties of citrus fruits, on account of citrus canker, except that oranges of the mandarin class (including satsuma and tangerine varieties) may be imported on compliance with the conditions prescribed in the regulations of the Secretary of Agriculture.

Sweet potato and yam.—Quarantine No. 29: Prohibits the importation for any purpose of any variety of sweet potatoes or yams (*Ipomoea batatas* and *Dioscorea* spp.) from all foreign countries and localities, on account of the sweet-potato weevils (*Cylas* spp.) and the sweet-potato scarabee (*Euscepes batatae*).

Banana plants.—Quarantine No. 31: Prohibits the importation for any purpose of any species or variety of banana plants (*Musa* spp.), from all foreign countries and localities, on account of the banana root borer (*Cosmopolites sordidus*).

OTHER RESTRICTIVE ORDERS.

The regulation of the entry of nursery stock from foreign countries into the United States was specifically provided for in the plant quarantine act. The act further provides for the similar regulation of any other class of plants or plant products when the need therefor shall be determined. The entry of the plants and plant products listed below has been brought under such regulation:

Nursery stock.—Nursery stock is entered under regulations requiring a permit, foreign certification and marking, reporting arrival and distribution, and inspection at destination. The term "nursery stock" includes all field-grown

florists' stock, trees, shrubs, vines, cuttings, grafts, scions, buds, fruit pits and other seeds of fruit and ornamental trees or shrubs, and other plants and plant products for propagation, except field, vegetable, and flower seeds, bedding plants, and other herbaceous plants, bulbs, and roots.

Irish potatoes.—The importation of Irish potatoes is prohibited altogether from the countries enumerated in the potato quarantine. Potatoes may be admitted from other foreign countries in accordance with the order of December 22, 1913, bringing the entry of potatoes under restriction on account of injurious potato diseases and insect pests. The following countries have qualified for the importation of potatoes under the regulations issued under said order: Denmark, Holland, Belgium, Cuba, Bermuda, and the Dominion of Canada. The regulations issued under this order have been amended so as to permit, free of any restrictions whatsoever under the plant quarantine act, the importation of potatoes from any foreign country into the Territories of Porto Rico and Hawaii for local use only and from the Dominion of Canada and Bermuda into the United States or any of its Territories or Districts.

Avocado, or alligator pear.—The order of February 27, 1914, prohibits the importation from Mexico and the countries of Central America of the fruits of the avocado, or alligator pear, except under permit and in accordance with the other provisions of the regulations issued under said order on account of the avocado weevil. Entry is permitted only through the port of New York and is limited to the large, thick-skinned variety of the avocado. The importation of the small, purple, thin-skinned variety of the fruit of the avocado and of avocado nursery stock under 18 months of age is prohibited.

Cotton.—The order of April 27, 1915, prohibits the importation of cotton from all foreign countries and localities, except under permit and in accordance with the other provisions of the regulations issued under said order, on account of injurious insects, including the pink bollworm. These regulations apply in part to cotton grown in and imported from the Imperial Valley, in the State of Lower California, in Mexico.

Corn.—The order of March 1, 1917 (Amendment No. 1, with Regulations, to Notice of Quarantine No. 24), prohibits the importation of Indian corn or maize in the raw or unmanufactured state from the countries and localities listed in Notice of Quarantine No. 24, except under permit and in accordance with the other provisions of the regulations issued under said order, on account of injurious diseases of Indian corn.

Cottonseed products.—The order of June 23, 1917, prohibits the importation of cottonseed cake, meal, and all other cottonseed products, except oil, from all foreign countries, and a second order of June 23, 1917, prohibits the importation of cottonseed oil from Mexico except under permit and in accordance with the other provisions of the regulations issued under said orders, on account of injurious insects, including the pink bollworm.

Citrus fruits.—The order of June 27, 1917 (Notice of Quarantine No. 28, with Regulations), prohibits the importation from the countries and localities listed therein of all species and varieties of citrus fruits, excepting only oranges of the mandarin class (including satsuma and tangerine varieties), on account of the citrus-canker disease. Oranges of the mandarin class (including satsuma and tangerine varieties) may be imported under permit and in accordance with the other provisions of the regulations issued under said order.

REPORT OF THE CHIEF OF THE BUREAU OF MARKETS.

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF MARKETS,
Washington, D. C., October 1, 1918.

SIR: I have the honor to transmit herewith a report of the work of the Bureau of Markets for the fiscal year ended June 30, 1918.

Respectfully,

CHARLES J. BRAND,
Chief of Bureau.

Hon. D. F. HOUSTON,
Secretary of Agriculture.

During the fiscal year ending June 30, 1918, emphasis was placed upon those phases of the work of the Bureau of Markets which would be most directly helpful to the Nation in successfully prosecuting the war with Germany. Projects of the greatest emergency value were expanded by the use of emergency funds appropriated by Congress, and the work of other projects was rearranged wherever it was possible to add to its immediate usefulness. Close cooperation has been maintained with the Food Administration, the War Industries Board, the Quartermaster's Department of the Army, the purchasing officers of the Navy, Councils of Defense, and all other Government agencies actively engaged in war work.

Wherever possible investigational work was superseded by demonstrational and service work, not because it was felt that these investigations were completed or should be discontinued, but because emergency conditions demanded that the knowledge and experience gained in previous years, especially that bearing on the more efficient distribution and conservation of food products, should be made immediately available.

The market news services on fruits and vegetables and live stock and meats, which had been established on a relatively small scale before war was declared, were widely expanded by the use of emergency funds. It was recognized that work of this character, valuable in time of peace, gained in usefulness in time of war on account of the imperative necessity of successfully conserving and making the most efficient distribution of the food supply of the Nation so as to make it adequate for our own needs and those of the Allies.

With the assistance of emergency funds it has been possible to build up a complete machine for the national interchange of market information on fruits and vegetables and to extend the service on live stock and meats, not as completely as desirable, but to a point where it meets much more adequately the needs of producers, consumers, and other interested persons. Market news services, financed with emergency money, have been instituted to cover dairy and poul-

try products, grain, hay, and milled feeds, and seeds. In addition to the telegraphic market news services, a local market reporting service has been instituted in about 15 cities. In the course of this work agents collect information regarding local supplies and prices of farm produce on city markets, special attention being given to that produced in contiguous territory. This information is published in nontechnical form in local newspapers.

The Food Products Inspection Service was instituted in the fall of 1917, as an emergency measure, to supply shippers with certificates regarding the condition as to soundness of their fruit and vegetable shipments upon arrival at large central markets. This service answered such an evident need on the part of producers and shippers that it was placed on a permanent basis by Congress, which inserted an appropriation therefor in the act making provision for the conduct of the Department of Agriculture in the fiscal year 1919.

Investigational work formerly undertaken in order to educate producers regarding the proper methods of picking, grading, packing, handling, storing, and shipping fruits and vegetables has been made the basis for extensive demonstrations, in order to apply at once the results of previous investigations. Much attention has been devoted to the proper construction of refrigerator and heater cars and storage houses, and the recommendations of this Bureau regarding car construction have been accepted by the Railroad Administration and other agencies, which have put them into immediate effect.

The staff of practical transportation experts of the bureau has been augmented, to assist shippers in obtaining cars, or to render other traffic assistance made necessary by the present unprecedented strain on the country's transportation facilities. All appeals for assistance in solving transportation problems which reach the Department of Agriculture are referred to this bureau for attention.

The food survey project conducted by the bureau constitutes our largest piece of emergency work not directly related to or developed from activities previously instituted. Interesting and valuable information has been obtained through this survey, which will be of great assistance in intelligently directing the consumption of the food supply of the Nation. Another large project undertaken by the Bureau of Markets as a piece of emergency work was the distribution to farmers of the nitrate of soda purchased by the Department of Agriculture under authority contained in the food control act.

The rules and regulations formulated for the conduct of the bureau's regulatory work were designed for operation in normal periods and, therefore, in some instances were not entirely suited to the changed conditions brought about by the war. It has been necessary, therefore, to revise them in some respects and to make some changes in the standards established for various commodities. The control of the wheat crop by the United States Food Administration Grain Corporation and the fixing of wheat prices made it necessary to revise the wheat standards established under the United States grain standards act, and extensive hearings were held throughout the country to insure due consideration of the interests of all before the revision was made.

The Bureau of Markets has been designated to perform the work incidental to stockyards control, recently instituted as a result of

the President's proclamation of June 18, 1918. Regulations for stockyards, commission men and all others dealing in live and dead stock in or in connection with stockyards were issued July 26, 1918.

The Bureau of Markets has labored under the same difficulties which recently have beset all civil branches of the United States Government, in obtaining and retaining the services of competent and qualified employees. Since war was declared it has lost over 264 men who have entered the military service. Several hundred employees have responded to the financial inducements offered by commercial agencies and the newer branches of the Government service not bound so closely as the older departments by statutory restrictions regarding promotions. Still others have left on account of the discouraging housing and transportation conditions encountered by persons residing in the city of Washington. These constant changes in personnel have made the conduct of effective work extremely difficult.

For the sake of convenience the work of the bureau is shown in the following detailed report under three classifications: (1) Investigational and demonstrational, (2) service, and (3) regulatory.

INVESTIGATIONAL WORK.

FOOD SUPPLY INVESTIGATIONS.

This work was instituted pursuant to an appropriation of \$50,000 to be used during the fiscal year 1918 for an investigation covering the "production, transportation, storage, preparation, marketing, manufacturing, and distribution of agricultural food products, including the extent, manner, and methods of any manipulation of the markets or control of the visible supply of such products, or any of them, by any individuals, groups, combinations, or corporations." A letter from the President, dated February 7, 1917, directed the Department of Agriculture to cooperate with the Federal Trade Commission in investigating and reporting the facts relating to the production, ownership, manufacture, storage, and distribution of foodstuffs and by-products, and in ascertaining the facts bearing on alleged violations of the antitrust acts, etc.

This agreement also provided that in so far as the live stock and meat industries were concerned all investigations of manipulations connected with the operation of public stockyards at centralized markets and all investigations affecting the operations and manipulations of packing companies should be conducted by the Federal Trade Commission, the activities of the Department of Agriculture ceasing at the time the live animals passed into the control of the packing companies.

Live stock and meats and the food-producing grains and their products have been the most important commodities involved in these investigations, which are under the direction of Mr. C. S. Cole.

Representatives of the Bureau of Markets have obtained 880 itemized records of individual shipments of live stock, either by following the stock from farms and ranches to shipping stations and from shipping stations to markets or by taking data relative to actual shipments from records which have been kept by farmers, live-stock shippers, and managers of live-stock shipping associations. The tabulations of these data show the shrinkage in transit and the cost

of marketing 29,980 hogs, 2,995 cattle, and 4,058 sheep. The records of hog shipments tabulated include 122 cars shipped during December, January, and February; 60 cars shipped during March, April, May, October, and November; and 10 cars shipped during June, July, August, and September, by farmers and local shippers or dealers; and 71 cars shipped during December, January, and February by cooperative live-stock shipping associations.

The investigations regarding grain marketing have been productive of valuable information which should enable this bureau to draw definite conclusions regarding the efficiency of various types of elevators, the results of the practice of mixing and conditioning grain, the conditions now governing the storage of grain, the effect of future trading on spot values, pit scalping, methods of handling grain in terminal markets, and the operation of "wire houses," grain exchanges, clearing houses, and grain commission firms.

Figures regarding operating costs for five years have been obtained from the books of over 400 elevators in North Dakota, Nebraska, Kansas, Oklahoma, and Colorado, and an intensive study has been made of the operation of over 130 elevators in Illinois and Iowa. Information has been obtained regarding the actual prices paid by elevators to farmers, the flow of grain by months, and the cost of handling grain, together with profits and losses.

An intensive study has been made of the operations over a period of five years of three large terminal elevator companies in Chicago. Information regarding the "in" and "out" grades and the total purchases and sales of cash grain for a period of five years has been obtained from the original records of these firms, and has been classified to show the source of grain supply, the period of heavy and light purchases, the class of dealer from whom grain was purchased, the basis upon which grain was bought, and the class of dealer to whom it was sold.

Copies of the leases of elevators owned by railroad companies have been secured, and the terms of these leases have been analyzed.

A detailed study has been made of the operation of large "wire houses" in Chicago. Financial statements have been examined which show profits and losses, costs of operation, and sources of income. An analysis has been made to show the occupation of the customers of and the mileage controlled by such houses, and the distribution of their branch offices and correspondents, together with the population they serve.

A study has been made of "pit scalping," in order to obtain definite information regarding the actual operations of typical pit scalpers, the functions performed by such operators, and the costs of their operations.

A comparative study has been made of the methods of clearing houses in Chicago, Minneapolis, and Kansas City. In this study information has been obtained regarding the organization, membership, rules, and operations of the various committees, with a view to ascertaining the reasons for their existence and the functions performed by each.

An analysis has been made of the accounts of the largest grain commission firms in Chicago. Costs of operation have been segregated, sources of profit have been carefully analyzed, and a general study has been made to ascertain the economic function which com-

mission merchants of this sort perform. Records were obtained from these firms regarding the purchase and sale of more than 250,000 cars of grain.

FOOD SURVEYS OF THE UNITED STATES.

These surveys have been conducted under the authority of the food production act and have been directly supervised by Mr. C. W. Thompson. Close cooperation has been maintained with the Food Administration, and the work contemplated for the coming year will follow lines laid down in conference with representatives of that body.

Information has been obtained regarding the quantities of important food commodities in the hands of manufacturers, storage concerns, wholesale and retail dealers, at various dates within the year, and regarding the stocks of raw materials on farms and foodstuffs in households. Two comprehensive surveys of commercial stocks have been completed, one under date of August 21, 1917, covering 18 selected items, and a second under date of January 1, 1918, covering 86 items. A comprehensive survey, covering the commercial holdings of 67 food commodities on July 1, 1918, is under way.

Information regarding farm stocks was obtained for the first and second surveys with the aid of the Bureau of Crop Estimates.

Reports of household stocks and household consumption were secured, in cooperation with the States Relations Service. In connection with this survey a special dietary study was undertaken, the results of which promise to be of great value.

To aid in determining the production of the various cereals for the crop year 1918, reports are being obtained direct from thrashers, with the assistance of the States Relations Service.

Since April 1, 1918, monthly reports with regard to commercial stocks of grains and grain products have been secured from elevators, mills, warehouses, and wholesale dealers in grain and flour, and since May 1, 1918, similar reports, covering sugar, condensed milk, and canned goods, etc., have been secured from wholesale grocers and from certain manufacturers.

The results of the survey of August 31, 1917, were published in six circulars in the Office of the Secretary series, reporting the supply in the United States of sugar, lard, canned salmon, and the commercial stocks of miscellaneous cereals, vegetables, foodstuffs, wheat and flour, and miscellaneous animal food products.

Since April, 1918, a monthly publication entitled "Food Surveys" has been issued, giving the results of the monthly reports above referred to. Special issues also have been published, giving in detail the results of the survey of January 1, 1918, with diagrams for the graphic presentation of important features.

FERTILIZER SURVEYS.

A survey relative to the supply of fertilizers and fertilizer materials on hand, imports, production, and producing capacity, was made under date of October 1, 1917, and supervised by Messrs. C. W. Thompson and D. S. Murph. Reports were obtained from all branches of the fertilizer industry, including importers, manufacturers, and mixers, miners (of phosphate rock), wholesale dealers, and retail dealers. The results of this survey were published in Office of the Secretary Circular 104, Commercial Stocks of Fertilizer

and Fertilizer Materials in the United States as Reported for October 1, 1917.

In addition to this general survey, a special inquiry was made, in cooperation with the States Relations Service, through the county agents, with regard to the immediate requirements for nitrate of soda

COOPERATIVE PURCHASING AND MARKETING.

This work, which is under the supervision of Mr. C. E. Bassett, has followed the lines laid down in previous years. The complexity of the marketing problems to be solved by producers has been greatly increased as a result of the war, and in many cases a solution can be reached only by cooperative effort.

Personal assistance in the solution of organization problems has been given in 25 States as follows: To vegetable growers in Florida, Rhode Island, and Alabama; potato growers in Montana, Nebraska, and Pennsylvania; onion growers in Texas; citrus fruit growers in Florida; dairy farmers in Maryland and Rhode Island; fruit growers in the Pacific Northwest, Michigan, Maryland, and the New England States; tobacco growers in Connecticut; honey producers in the Intermountain States; hay growers in New York; bean growers in Colorado and New Mexico, and cotton growers in Arizona. In a large number of instances assistance was given also by means of correspondence. Organization questions were discussed and explained at a number of farmers' meetings, short courses, conferences, and conventions.

The organization of a number of farmers' grain elevators was studied, and information was secured to be used in rendering assistance to such organizations in the future.

The survey of the extent of cooperation in the United States which was started some years ago was continued, and information was secured from a large number of farmers' organizations not hitherto listed. This survey supplies valuable information relative to the cooperative movement in the United States as a whole.

MARKET SURVEYS, METHODS, AND COSTS.

Most of the work conducted under this project is done in connection with the market news service on fruits and vegetables, that service having been based upon the information obtained in these investigations. This project is supervised by Mr. Wells A. Sherman. Owing to the great volume of work coincident with the expansion of the market news service on fruits and vegetables, these investigations necessarily have been greatly restricted of late.

Through arrangements with the common carriers the Bureau of Markets receives daily mail reports of shipments of fresh or dried fruits and vegetables originating on all of the important railroads and boat lines in the country. Approximately three-quarters of a million carloads of 100 different commodities are now reported in this manner each year. These reports are first assembled at seven of the permanent market stations at central points, and the totals are wired to Washington for publication. A semiweekly bulletin is issued regarding the shipment of all fruits and vegetables not covered by the telegraphic market news service.

At the 32 market stations established in connection with the market news service on fruits and vegetables daily reports have been secured regarding carlot shipments of 16 of the more highly perishable fruits and vegetables unloaded in these cities. These data, properly tabulated, should be of much value in determining the consuming capacities of the various cities and in studying their sources of supply.

A detailed market survey of Maricopa County, Ariz., made in cooperation with the project "State Cooperation in Marketing Work," was completed during the fiscal year 1918. This investigation, extending over a period of nearly eight months and including all phases of the marketing problem, probably represents the first complete market survey made of a community. The work was carried on in cooperation with the University of Arizona, and the practical results of the study have been eagerly sought by the producers of the county.

MARKET GRADES AND STANDARDS.

In this work, which is under the direction of Mr. W. M. Scott and Mr. C. T. More, investigations are made of present methods of handling, grading, packing, and shipping fruits and vegetables, in order to recommend improvements therein. During the past year valuable information has been assembled, grade specifications have been recommended for Irish potatoes and Bermuda onions, and tentative grades have been worked out for several other commodities. An increasing interest in the work done by this Bureau in formulating standard grades for fruits and vegetables has been observed throughout the country.

Detailed studies were made regarding the methods of harvesting, grading, packing, and shipping apples, peaches, and Florida citrus fruits and also of the arrangement, equipment, and management of packing houses. In the course of these investigations consideration was given to the possibility of establishing uniform grades for these fruits and specifications for such grades. Complete information is now available for bulletins on the preparation for market of peaches and barreled apples, and tentative grade specifications have been prepared for both boxed and barreled apples and citrus fruits. However, further investigations and practical demonstrations on a large scale will be necessary before these grades can be definitely recommended.

Former investigations regarding practices and conditions at producing and receiving points and the methods of preparing and shipping potatoes, Texas Bermuda onions, tomatoes, sweet potatoes, cabbage, peanuts, beans, lettuce, celery, and other truck crops have been continued.

As a result of this work Markets Document 7, containing official potato grades, was issued by the Bureau of Markets, in cooperation with the United States Food Administration. On January 31, 1918, these grades were promulgated by the Food Administration, and their use by its licensees was made compulsory.

Grades for domestic Bermuda onions also were recommended by this bureau and officially promulgated by the Texas State Department of Agriculture.

Practical tentative grades have been prepared for tomatoes, sweet potatoes, and cabbage.

Investigational work relating to the standardization of containers for fruits and vegetables was largely confined during the year to the study of hampers and round baskets. In the absence of corrective legislation, "short" packages in certain sections of the country almost have driven the standard one-half bushel and one bushel hamper from the market. "Short" baskets also are being used instead of the full measure one-bushel round basket. Through the continued efforts of the Department of Agriculture and the departments of weights and measures of certain States, many manufacturers voluntarily discontinued the manufacture of such "short" containers during the past year. There appears to be an increasing demand throughout the country for further standardization of packages.

CITY MARKETING AND DISTRIBUTION.

During the past year there has been an awakened interest in municipally owned retail public markets and, to some extent, in wholesale terminal produce markets, as a means of lowering or at least retarding the advancing prices of perishable farm products. The studies regarding such markets have been under the direction of Mr. G. V. Branch since their inception.

Surveys of marketing conditions and facilities have been made during the past fiscal year in greater or less detail in Lynchburg, Va.; Oil City, Pa.; Denver and Colorado Springs, Colo.; Salt Lake City, Utah; and Springfield, Mass., and in each case definite recommendations have been made regarding improvements. As a result, successful public farmers' markets have been put in operation in Lynchburg and Springfield and plans are under way for extensive improvements in Denver and Salt Lake City. Advice on this subject has been given to city authorities in Chicago, Detroit, Pittsburgh, Cleveland, and Baltimore.

Moving pictures of the operation of public markets of both the open and inclosed types were taken in the northern and eastern States and are now being prepared for exhibition for demonstrational purposes.

In order to ascertain the extent of the marketing problems involved in the home-garden movement, investigations were made in a large number of cities of various sizes and types. It was found that very few home gardeners intended their products for sale and that the only marked effect which probably would be produced by home-garden production would be the somewhat restricted outlet which would be left to commercial growers.

Progress was made in designing, constructing, and testing a combined refrigerated display and storage counter for the handling of meats and fish. Studies have been continued regarding types of counters especially adapted for use in inclosed public markets, and for the proper display and handling of fruits, vegetables, dairy products, etc. Most public markets have been found to be very deficient in attractive, efficient, and sanitary stall equipment, and efforts are being made to design improved and economical equipment of this nature. Special assistance was given in Wilkes-Barre, Pa., regarding the design, construction, and management of a large public market.

Considerable information has been secured regarding the operation of chain stores, independent "cash-and-carry" stores, concerns operated under the segregated-charge-for-goods-and-service plan, and "self-serve" stores.

More detailed information in regard to the newer methods of food-stuff merchandizing is being collected and will be made the basis of suggestions for improving marketing methods.

TRANSPORTATION AND STORAGE.

The Transportation Division of this bureau is directed by Mr. G. C. White. Its great value lies in the fact that it acts as a traffic department for the entire bureau and, since the present emergency began, for the entire department as well.

As was the case in previous years, the greater part of the work of this project consisted in making arrangements with common carriers to render reports of shipments to be used in connection with the various market news services of this bureau. As a result of this work these reports were secured with greater regularity, promptness, and accuracy. The enactment by Congress of the food production act (Public No. 40, approved Aug. 10, 1917), which gave the Secretary of Agriculture authority to require the carriers to furnish certain information, together with the creation of the United States Railroad Administration, has aided this bureau greatly in its negotiations with the carriers.

In the performance of this work 11 men spent during the fiscal year an aggregate of 1,065 days in the field and traveled an aggregate of 159,093 miles. Under the head of "Service" a description will be found of the emergency traffic assistance rendered by this project to shippers and others.

Five hundred and eighty-one common carriers made reports of this kind. These carriers control 258,709 miles of the total railroad mileage in the United States—i. e., 265,000 miles. The term "common carrier" as used in this connection includes railroads, express companies, and boat lines.

During the year there was prepared for the use of Federal reserve banks a chart showing suitable storage conditions for 11 commodities usually held in storage. This chart was intended to provide information in ready reference form for the use of bankers in making loans on the security of stored commodities.

Investigations also are made regarding storage rates, and the economic phases of the storage question. On behalf of the Quartermaster Corps of the United States Army a survey was made to determine the amount of storage space available in the United States.

DIRECT MARKETING.

This work, which is under the supervision of Mr. Lewis B. Flohr, was broadened as much as possible with emergency funds, although great difficulty was experienced in getting competent men. The increased usefulness of direct marketing under emergency conditions became apparent at once, because the high prices received for food-stuffs now make it profitable to sell in this manner certain products which could not be so marketed under normal conditions. It is also possible to sell in this way small quantities of food products which

otherwise would be wasted, and thus add to the quantity of food available for consumption.

During the fiscal year 1918, 197 experimental shipments of fruits, berries, vegetables, eggs, butter, poultry, fish, honey, sirup, and nuts, aggregating a weight of 5,783 pounds, were made by parcel post and express over distances totaling 61,108 miles. This experimental work has demonstrated that in nearly every case the success of a shipment depends on the quality of the product shipped, the type of container, and the care used in packing. The value of a commodity in proportion to its weight and the price which can be obtained by marketing through other channels ordinarily are the factors to be considered in determining the desirability of marketing by parcel post or express.

Studies to determine the possibility of direct marketing were made in the vicinity of Philadelphia, Pa., Brooklyn, N. Y., St. Louis, Mo., Syracuse, N. Y., Jacksonville, Fla., Boston, Mass., Bridgeport, Conn., New York City, and several places in the State of Ohio, and investigations also were made in the territory served by several of the rural parcel-post motor routes centering in Philadelphia, Pa., Washington, D. C., and Baltimore, Md. Demonstrational work was done coincident with these investigations to acquaint producers and consumers with the possibilities of direct marketing and the proper methods to be employed in connection therewith. Close cooperation with the Post Office Department was maintained in this work.

Information and assistance were given by the project leader in solving the problems of marketing the products of girls' canning clubs.

MOTOR TRANSPORTATION OF FARM PRODUCTS.

This work, which is under the supervision of Mr. J. H. Collins, was not begun until March 15, 1918, and it is impossible therefore to draw definite conclusions from the investigations conducted. From the start systematic effort has been made to emphasize those phases of the subject which may be of assistance in solving the transportation problems caused by the war. Especial consideration has been given to obtaining better transportation conditions in rural districts where rail transportation is proving inadequate at present.

As a preliminary to constructive work it was necessary to secure adequate information regarding the actual operating costs of rural transportation routes, and detailed information covering sixty such routes was obtained. These data covered all possible items of cost, and, in addition, supplementary reports were made for each route regarding operating conditions, business methods, facilities, and general management.

As soon as the information mentioned above was obtained it was utilized for demonstrational purposes. Detailed studies were made in a large number of districts, particularly in New Jersey, Pennsylvania, New York, Ohio, and Connecticut, looking toward the establishment of additional motor freight and express lines, and as a result of this work five demonstrational routes were actually started and have been successfully operated. Arrangements were made with the owners and operators of motor trucks to conduct these experimental routes under the supervision of the Bureau of Markets, and many new routes are in process of establishment.

One of the most noticeable obstacles to the development of the motor express industry is the lack of proper terminal facilities. Detailed investigations have been made in Baltimore, Buffalo, and Philadelphia, and the feasibility of establishing central terminals for motor trucks in these cities has been thoroughly studied.

To assist in systematizing the business methods of the motor trucking industry a standard cost-accounting system has been devised and is being distributed to operators who have agreed to furnish this bureau with duplicate copies of their cost record. The need for a uniform bill of lading covering shipments by motor trucks has been evident for some time, and at the request of some of the more important trucking companies a standard bill of lading is being designed and will be ready for distribution in the near future.

The question of adequate protection for shippers also has been a pressing one, and in view of the fact that existing insurance policies do not cover shipments by motor truck, it has been necessary to draft a model set of provisions for incorporation in insurance policies to cover such shipments. This work has not been completed, but it is hoped that copies of these provisions may be distributed to insurance companies very soon.

On account of congested transportation facilities the bureau has instituted an experimental emergency service in supplying trucks to move crops in certain producing districts. This is described under the section relating to the bureau's service work.

MARKET BUSINESS PRACTICE.

Assistance in the installation and operation of the various accounting systems devised and published by this bureau has been given by representatives of the project wherever possible. This work was carried on under the direction of Mr. G. A. Nahstoll.

A preliminary survey has been begun, to devise a system of cost accounting for cold-storage warehouses. This work has been conducted in New York, Boston, Providence, Philadelphia, St. Louis, Chicago, and Minneapolis, and a tentative outline for cost segregation has been prepared.

The system of accounts for fruit-shipping organizations, which was described in detail in last year's annual report, has been supplemented by forms for recording packing operations in community packing houses, and an adaptation of the forms comprised in this system has been made to meet the special requirements of tomato-shipping associations. The system so modified has been installed in the offices of a large growers' association in Florida.

In accordance with many requests careful studies have been made of the methods used by milk-distributing plants and a system of accounting has been installed for experimental operation in plants at Grand Rapids, Mich., and Burlington, Vt. This work will be extended to other cities as rapidly as possible in order to study the practices in different markets and to test the tentative system under varying conditions.

A simplified system of accounting has been devised for use by organizations formed for the purpose of dealing in farm and household supplies. Although there is a wide difference in the business methods employed by these organizations, it has been found that the forms

may be adapted to the needs of small cooperative stores and practically all purchasing organizations, such as buying clubs and farmers' exchanges. Installation of the system has been made in 10 organizations and their experimental operation is proving satisfactory.

During the last season a large number of community canneries were opened in many sections of the country, and there has been a growing demand for a system of records to register the transactions incident to the trading of commodities between patrons, the amounts expended for labor and supplies, and the charges made for service. A system for recording these transactions has been devised and is now being used experimentally.

In view of the changes brought about through the adoption of the new grain standards, it was found necessary to make certain revisions in the system of accounts for grain elevators. The new forms will meet present requirements more adequately than the old and their adoption by most of the users of the system is expected.

On request studies have been made of the methods of operation of sirup-packing plants and a tentative outline of a system of accounting for such agencies has been prepared and installed in a plant at Kirbyville, Tex., for experimental use. An accounting system has been devised for use by sweet-potato curing plants.

Special efforts have been made to render assistance in installing in country creameries the system of accounts devised for their use. A large number of organizations have adopted this system. Representatives of the bureau have visited many of the farmers' creameries in the States of Vermont, Michigan, Minnesota, Illinois, Ohio, North Carolina, South Carolina, Georgia, Alabama, Louisiana, Mississippi, and Tennessee, in order to assist in the installation and operation of the system.

FOREIGN MARKETING INVESTIGATIONS.

The foreign marketing investigations, under the direction of Mr. Clarence W. Moomaw, were planned primarily for normal conditions when our foreign trade in agricultural products was handled through regular trade channels, and much of the work recently done has been conducted in preparation for extending aid to producers and shippers at the conclusion of the war when normal conditions are restored.

Late in the fiscal year 1917 a special investigator was sent to study the possibilities of marketing American fruits in the Far East. These investigations were carried on in China, Japan, eastern Siberia, and the Philippines. Information on this subject was made available to Pacific coast shippers for their guidance during the fruit season of 1917-18.

In conformity with an arrangement with the Food Administration, Dr. J. W. T. Duvel, crop technologist in charge of the grain standardization investigations of the Bureau of Markets, was sent to Australia to investigate the supply and condition of grain in that country, where large amounts have accumulated on account of the impossibility of transporting it to Europe. The principal grain centers of that country were visited and definite arrangements were made for the selection and inspection of grain intended for shipment to the United States.

A special investigator was sent to Australia and New Zealand to study the possibilities of marketing American fruit in that region,

and to investigate the conditions surrounding the live-stock, meat, dairy, and wool industries of those countries. This investigation probably will not be completed until the fall of 1918.

Economic conditions and agricultural market developments throughout the world have been studied, foreign publications examined, and the information resulting therefrom compiled for use in answering inquiries.

PRESERVATION OF FRUITS AND VEGETABLES IN TRANSIT AND STORAGE.

For several years the Department of Agriculture has conducted investigations to determine the amount of deterioration which is caused by the manner in which fruits and vegetables are harvested, packed, stored, and shipped, and, by the use of emergency funds, extensive demonstrations are being made to bring about the practical application of the information obtained in these investigations. This work, which is under the supervision of Mr. H. J. Ramsey, was formerly carried on in the Bureau of Plant Industry in conjunction with other work of a similar nature. In order to place the marketing phases of these investigations within the proper bureau, the work described below was transferred to the Bureau of Markets upon recommendation of Dr. William A. Taylor, Chief of the Bureau of Plant Industry, provision being made for such action in the estimates for the fiscal year 1919.

Studies regarding methods of harvesting and handling fruits and vegetables have been continued along lines previously established. During the past year Florida oranges, strawberries shipped from Florida, Louisiana, and Missouri, tomatoes, other southern vegetables, and cantaloupes shipped from California, Arizona, and Colorado have been made the subject of such investigations. Studies have been made of the degree of maturity at which cantaloupes, tomatoes, and some other vegetables should be picked, and of the effect of delay between picking and shipping fruits and vegetables. Data secured in an investigation regarding the desirability of wrapping Florida oranges have shown that oranges shipped unwrapped arrive in the market in practically as good condition as those that are wrapped. By eliminating wrapping, large unnecessary costs may be saved and the shipment of the fruit may be greatly facilitated.

Every effort has been made to demonstrate to growers and handlers of fruits and vegetables that decay and deterioration in transit can be reduced by the introduction of more careful and efficient handling methods. It was found that in many sections where work of this nature has been carried on previously there was a tendency on the part of shippers to permit handling standards to be lowered because of the difficulty of obtaining experienced labor. So far as possible this tendency was counteracted by educational work, and in many sections where work had not previously been done demonstrations were made throughout the shipping season.

Studies of the efficiency of refrigerator cars used for the transportation of fruits and vegetables were continued, and extensive demonstrations were made of the practicability, through modifications in construction, of increasing the efficiency of such equipment and of effecting economies in the transportation of perishable shipments. Practically all of the refrigerator cars built during the past year conform in principle to the designs recommended by this bureau,

and the United States Railroad Administration has adopted, as standard, the type of car which these investigations have shown to be the most efficient.

Test shipments were made of fruits and vegetables under ventilation, and it was shown that heavy loads may be moved under ventilation with as low temperatures as light loads.

Extensive investigations relative to the protection of perishable shipments from frost damage in transit were conducted, and the data obtained in this work show clearly the fundamental factors necessary for satisfactory frost protection. During the summer of 1918 tests were conducted in cooperation with the United States Railroad Administration to determine the best methods of constructing heater cars.

Demonstrations were made to railroad officials, growers, and shippers in many sections of the United States regarding the possibility of frost protection, and the relation of loading methods, car construction, insulation, and refrigeration to decay and deterioration in fruit and vegetable shipments.

Serious damage has been caused in the past by improper methods of loading shipments of fruits and vegetables. Investigation of this problem was begun in the fall of 1917 and continued throughout the season, and demonstrations of the factors to be considered were made both at shipping and market centers. This work has resulted in the adoption of regulations by shippers and railroad officials which will undoubtedly reduce losses from poor loading. Particular emphasis was placed on demonstrations designed to show the possibility of loading perishable shipments more heavily.

Investigations have been made of the factors governing the successful storage of fruits and vegetables, and the results of these studies have been made the basis of demonstrations. In the West and Pacific Northwest more than 100 common storage houses for apples have been constructed or remodeled in accordance with the plans or suggestions of this bureau. Important improvements have been effected in the construction, ventilation, and management of houses and cellars intended for the storage of Irish potatoes, and plans were completed for the erection, in accordance with this bureau's recommendations, of several hundred sweet-potato storage houses during the summer and fall of 1918.

MARKETING DAIRY PRODUCTS.

Investigations regarding the marketing of dairy products which were started in 1914 were continued during the fiscal year 1918, under the direction of Mr. Roy C. Potts.

An investigation of the economic problems arising in connection with the marketing of fluid milk in the larger and more important cities in the United States was completed and the operation of milk producers' marketing associations was studied, assistance being given in improving their methods of marketing. Particular consideration was given to those associations which operated distributing plants.

Studies were made in a number of cities regarding the supply of and demand for fluid milk and cream, butter, eggs, and cheese, with the view to outlining definite plans for the establishment of a market reporting service.

Consideration has been given to the establishment of an inspection service for butter, tentative plans for such a service having been outlined and tentative rules governing such inspection having been prepared.

A special investigation was made in cooperation with the College of Agriculture regarding the marketing of dairy products in Mississippi, especially creamery butter. Assistance was given to the creameries of Mississippi in improving marketing methods.

Investigations were made in 14 cities of the prevailing methods of marketing cottage cheese and of the conditions surrounding this industry. In each of these cities assistance was given to distributors of cottage cheese in increasing their outlets of sale and improving their methods of marketing.

A dairy marketing survey was made in Colorado, particular attention being given to the relation of dairying to the agricultural development of that State.

MARKETING LIVE STOCK, MEATS, AND ANIMAL BY-PRODUCTS.

The investigational work of this project, which is under the supervision of Mr. Louis D. Hall, was conducted along lines that promised to be most immediately useful in the present emergency. Special attention was given to the matters mentioned by the President in directing this department to cooperate with the Federal Trade Commission in investigating questions relating to the meat supply of the country.

Investigations regarding cooperative live-stock marketing have been continued. In Georgia, farmers have been assisted in marketing their hogs at cooperative sales, and in other States assistance of a similar character has been rendered. The survey of centralized live-stock markets has been continued, and conditions and facilities at a number of feeding and finishing stations and transfer points near centralized markets have been investigated. The work of tracing shipments to centralized markets has been extended in connection with the cooperative investigation carried on by this bureau and the Federal Trade Commission. Investigations relating to the wholesale slaughter and distribution of meats also have been extended in connection with the same work. A detailed study of the physical phases of utilizing packing-house by-products was undertaken in order to determine the methods and costs of obtaining maximum results in the conservation and utilization of animal by-products. Field investigations and demonstrations regarding methods of marketing live stock have been conducted in Arkansas, Texas, North Carolina, New Mexico, Vermont, Georgia, Minnesota, and Montana. A general survey of principal feeding districts and grazing sections has been made, including specific studies of the Lancaster district in Pennsylvania and the Arkansas Valley in Colorado. Detailed information was collected concerning the Fort Collins, Colo., district, and the Big Hole Basin of Montana. A special survey was made in southwest Virginia to ascertain the prevalent methods and costs of marketing fat cattle, the relative efficiency of the various methods, and the marketing facilities available in that locality. A detailed study of the soft-pork problem in the South was made in order to determine a basis for differences in prices which should be paid for live hogs classed as "oily" and those classed

as "firm." Plans were made for a comprehensive study of the marketing of pure-bred live stock, with a view to guiding buyers and sellers in domestic trade and assisting in supplying the post-war needs of foreign countries for pure-bred stock.

The compilation of data relative to the marketing of wool has been continued and assistance has been rendered to other departments of the Government in matters pertaining to the textile industry and wool distribution and consumption. The preparation of type samples of the various commercial grades of wool was undertaken at the instance of the War Department, approximately 1,500 samples of the various grades and types of domestic wool having been collected from more than 1,100 manufacturers and wool dealers.

SEED MARKETING INVESTIGATIONS.

These investigations are directed by Mr. W. A. Wheeler, who is also in charge of the emergency Seed Reporting Service. Owing to the facilities available for the conduct of the Seed Reporting Service, it has been possible to obtain information regarding the economic phases of seed marketing which could otherwise not have been secured.

The transactions in clover seed for the period of a month at the leading markets for that commodity were examined to determine what effect, if any, speculation had on the price of red-clover seed in February, 1918. It is thought that this work, taken in conjunction with the publication of figures showing the stocks of clover seed that were being held for export to foreign countries, had a material effect in lowering the price of red-clover seed to farmers at a time when it seemed that it would soar above the record of \$21 per bushel on February 13, 1918.

Samples of country-run seed were obtained from different sections of the country and comparisons of these samples indicate that prices of country-run seed in various producing areas vary considerably.

Copies of contracts entered into between small seed growers and large commercial seed growers, and between the latter and wholesale and retail seedsmen, have been obtained and examined in order to detect any unfair practices existing.

Field-seed prices, as quoted at several of the most important markets, have been tabulated to determine, if possible, the differences in price prevailing at such markets, and investigations have been made to determine what might, under ordinary conditions, be considered reasonable differences in wholesale and retail prices of seeds. Inquiries have been made to ascertain the time at which various kinds of seed begin to move from growers' hands to dealers' hands, when the movement is general, and when it is normally at an end. Inquiries also have been made to learn what percentage of growers sell seed and whether they sell to the local buyer, to the traveling buyer, by correspondence with distant seedsmen, by advance growing contracts with commercial seed growers, through local or farm paper advertising, or direct to neighbors.

COTTON HANDLING AND MARKETING.

Earnest effort has been made, under the leadership of Mr. Fred Taylor, to bring about such economic reforms and improvements as may be necessary to facilitate the movement of the cotton crop in the

present emergency. In order to accomplish this, cooperation has been maintained with the War Industries Board.

Studies and demonstrations regarding the cooperative handling and marketing of cotton were made during the season of 1917-18 in North Carolina, South Carolina, Georgia, Mississippi, Arkansas, Oklahoma, Texas, New Mexico, Arizona, and California. In the course of this work cotton specialists classed cotton for farmers before sale in order to demonstrate the value of this practice, suggested improvements in the methods of marketing, urged the growing of better varieties, organized growers on a community basis, demonstrated the effect of short-staple varieties in lowering prices, advocated the sale of cotton in even running lots of grade and staple, and emphasized the importance of proper ginning and the value of proper warehousing.

In North Carolina, a survey was made to determine the character of cotton consumed by cotton mills, and producers were urged to grow cotton needed by the manufacturers. Studies of the operation of the warehouse acts of South Carolina and Arkansas were made in those States.

Assistance was given in organizing a farmers' association at Sumter, S. C., through which approximately 15,000 bales of cotton were classed and marketed. Growers of long-staple cotton in Mississippi were assisted to organize, and growers in 14 counties in Texas and 2 counties in Oklahoma were helped in forming associations for the growing of one variety of cotton on a community basis.

The studies conducted by this project have shown that in many instances local buyers are not aware of the true market value of the various classes of cotton. At Altus, Okla., bids of 27 cents per pound and less were made for cotton of a superior variety. Thirty-five bales of this cotton were then shipped to New Orleans and sold through a cotton factor for 33 and 35 cents per pound. This gave great impetus to the planting of this variety in that locality.

Approximately 75,000 bales of cotton have been classed for the producers in the primary markets for the States of North Carolina, South Carolina, Georgia, Mississippi, Arkansas, New Mexico, Oklahoma, and Texas during the past season, in order to demonstrate the advantages of classing before sale.

Investigations of the marketing of cotton in the seed before ginning were continued in Oklahoma and extended to the States of Arkansas, Missouri, Kentucky, Tennessee, Virginia, and North Carolina, these being the only States in which this practice prevails to an appreciable extent. The data obtained show that the sale of cotton in the seed is attended by many uncertainties, making it impossible for the buyer to discriminate between the values of different qualities of cotton.

In cooperation with the project "Cotton Warehousing Investigations," a study was made of gin sampling under the Texas and Arkansas warehouse laws. Samples of both pressed and unpressed cotton were collected from 5,418 bales. The results of this investigation indicate that this method of sampling is economically more efficient than that generally employed. The practice of classing cotton by samples cut from the bales, however, is of long standing, and the unwillingness of men in the cotton trade to revise or change this custom presents a serious obstacle to bringing about the general use of gin samples.

During the present emergency it is exceedingly important that all gins cooperate in standardizing the dimensions of cotton bales, and ginnermen who have not adopted the standard 54 by 27-inch gin box were urged to do so immediately.

Experiments made in cooperation with the project "Cotton Testing" indicate that cotton of the various staple lengths which have been tested may safely be compressed to a density of 35 pounds per cubic foot without damaging the spinning quality of the fiber. Owing to congested transportation conditions, high compression is desirable, as less car space is necessary to move cotton so compressed. High density compression is being urged by the bureau in cooperation with the War Industries and Shipping Boards and the Railroad Administration.

MARKETING COTTON SEED AND ITS PRODUCTS.

The work in marketing cotton seed and its products is conducted by Mr. C. F. Creswell under the supervision of Mr. Fred Taylor.

Conditions surrounding the transportation of cotton seed are being investigated to determine the extent of cross shipments and the percentage of foreign matter (oil, meal, hulls, and linters) contained in commercial lots of cotton seed from various sections. An enormous amount of useless foreign matter is mixed and transported with cotton seed annually. This practice requires the use of many additional freight cars and entails, in the aggregate, enormous charges for freight and handling expenses, wear on machinery, and danger to the health of workmen. Efforts are being made to ameliorate this evil by educational work. The Department of Agriculture, through the Bureau of Chemistry, recently ruled that the return of foreign matter to cotton seed after separation at the gin, or the deliberate addition of foreign matter to cotton seed, constitutes an adulteration under the provisions of the Federal food and drugs act. This ruling should assist greatly in putting a stop to this practice.

As a means toward the elimination of waste and the improvement of marketing conditions, the feasibility of establishing practical grade standards for cotton seed has been studied. It has been found that there is a general desire for such standards, and as a result of conferences with representatives of this bureau, the Interstate Cotton Seed Crushers' Association has officially announced a basis for standardization devised by the bureau which has been incorporated in the rules of that association.

Conditions governing the handling and marketing of cotton linters have been investigated. Special attention has been given to the different qualities of linters and to the practicability of standardizing this commodity. Four tentative standards for linters have been prepared by this bureau and have been recommended by the War Industries Board for use in the purchase and sale of all unsold linters of the 1917 crop, which are of higher grade than munition linters. Owing to the great demand for munition purposes, oil mills have increased the cutting of linters from about 50 pounds per ton of seed to a minimum of 150 pounds, sometimes cutting as much as 225 pounds to a ton of seed. Consequently, mattress, batting, and felt makers, as well as other manufacturers, have been obliged practically to discontinue the use of linters on account of the high prices prevailing, their low quality, and scarcity.

COTTON WAREHOUSING INVESTIGATIONS.

Cotton warehousing investigations have been continued under the direction of Mr. R. L. Nixon, following mainly the same lines pursued in the past.

Information has been secured from many cotton warehouses in addition to those previously listed, regarding capacity, manner, and cost of construction, insurance rates, storage charges and loans, and interest rates on stored cotton.

Exhaustive tests have been made, in cooperation with the project "Cotton handling and marketing," to determine the practicability of grading cotton by samples secured at the cotton gin. Tests also have been conducted in cooperation with the same project to determine the extent to which cotton is damaged when exposed to the weather, the purpose of these tests being to demonstrate the economic importance of warehousing.

Information on the subject of cotton warehouse operation and management has been compiled and will be available for publication within a short time.

Studies of State warehouse laws have been continued, and conferences have been held with State officials regarding proposed warehouse laws.

INVESTIGATION AND DEMONSTRATION OF COTTON STANDARDS.

This work is supervised by Mr. Fred Taylor, and during the past year has dealt mainly with questions relating to the establishment of standards for Arizona Egyptian cotton and Sea Island cotton and standards for length of staple. During the year 1917-18 extensive investigational work was done in Arizona and California to determine the suitability of tentative standards which had been established for Arizona Egyptian cotton.

In December, 1918, representatives of the Department of Agriculture were sent to Savannah, Ga., to class 15,000 bales of Sea Island cotton, purchased by the Signal Corps, for the manufacture of airplane fabric. This work necessitated the preparation of standards for Sea Island cotton, and a tentative set was submitted to the Savannah Cotton Exchange for examination. It was approved by a representative committee of exchange members, and standards covering five grades were then prepared for Georgia and Florida Sea Island cotton. When these standards have been officially promulgated they will be distributed for use during the season of 1918-19.

Representatives from the department have made surveys in the New England and Southern States, interviewing cotton manufacturers, merchants, and brokers, to obtain their opinion regarding the practicability of formulating standards for cotton of various staple lengths. It was found that 69 per cent of the cotton trade desired the establishment of such standards by the department. Most of those interviewed furnished types representing their idea of various staple lengths. Careful examination of these types, under uniform humidity and temperature conditions, indicated that the opinion of the trade harmonized very closely with that of the department in this respect.

It is now planned to promulgate and distribute, in time for use in classing the 1918 crop, types representing American Egyptian cotton

with staple length of $1\frac{1}{2}$, $1\frac{5}{8}$, and $1\frac{3}{4}$ inches and Sea Island cotton of $1\frac{1}{2}$, $1\frac{5}{8}$, and $1\frac{3}{4}$ inches. Standards will be established to cover American Upland cotton with staple length from $\frac{7}{8}$ of an inch to $1\frac{1}{2}$ inches. These standards will be ready for use in connection with the 1919 crop.

COTTON TESTING.

On account of the scarcity of linen and the consequent necessity for producing airplane fabric from cotton, the regular work of this project, which is directed by Mr. Fred Taylor, was suspended during the fiscal year 1918. Conferences were held between representatives of the Bureau of Standards, of the Department of Commerce, the Bureaus of Plant Industry and Markets, of the Department of Agriculture, and the Signal Corps of the War Department, and in August, 1917, tests were instituted to determine the possibility of using American Egyptian, Sea Island, and regular Egyptian cotton of the Sakellaridis variety for this purpose. The most important factors to be considered were tensile strength, tearing strength, and elasticity.

At the suggestion of the Signal Corps, two fabrics of entirely different construction were first made the subject of experiment. Various weaves were tested, such as the "basket," "broken twill," and "straight twill."

Tests have been made to determine the "twist per inch," to be used in single and double-ply yarns in order to produce maximum strength with minimum stretch, and the results of this bureau's recommendations have been incorporated in the specifications now being used by the Signal Corps. Tests were made to determine the effect of mercerizing on the strength and elasticity of cotton goods, and experiments were made to determine the kinds of fabrics satisfactory for airplane manufacture, which could be produced in the least time and at the least expense.

At the request of the Signal Corps, a new line of investigation is being undertaken to determine the best methods of constructing balloon fabrics. No definite conclusions have yet been reached in all of this work on account of the fact that the requirements for airplane fabric change constantly.

GRAIN STANDARDIZATION.

When the Federal grades for wheat became effective, most of the energy of those formerly engaged in formulating grain standards was absorbed in assisting with the large amount of regulatory work necessary to put into effect the provisions of the United States grain standards act. The nucleus of a staff to perform investigational work of this kind was kept intact, however, and these activities have now been reorganized for active prosecution. The standards already established are studied constantly to determine the necessity for modifications, and such investigations are made as may be necessary to establish standards for other grains, and to study problems of handling, storage, dockage determination, and milling and baking values. This work is under the direction of Dr. J. W. T. Duvel.

As a result of study regarding the adaptability of the present corn standards to commercial conditions, they have been slightly changed. The adaptability of the wheat standards also has been studied closely,

and they have been revised to make them more applicable under war conditions.

Storage experiments have been carried on in the Pacific Northwest to determine the increase in moisture content and gross weight of wheat stored at the terminals and at country points, and methods have been devised for determining the proper percentage of dockage to be assessed. Extensive investigations have been made of the problem of smut eradication, of cleaning grain on the farm to reduce dockage and foreign material content, and of preventing dust explosions in thrashing machines. The results of work done in the summer of 1917 indicate that the condition and grade of wheat can be materially improved and its market value increased by attaching a simple device to thrashing machines. This work was done in cooperation with the Bureaus of Chemistry and Plant Industry. Average price quotations received from grain dealers in Tacoma, Seattle, Spokane, and Portland on 32 representative sets of samples showed that wheat thrashed by machines so equipped brought about 2½ cents per bushel more than other wheat from the same section. As a result of these investigations, many of the larger thrasher manufacturing companies are sending out especially equipped machines this year, and increasing interest in this matter is evident, especially in smut-infected areas.

Nematode galls, the result of a comparatively new and rare disease in the United States, have been found in some samples of wheat, and investigations are now being made to determine the extent of this disease and the proper method of handling wheat so infected.

Tentative grades for oats have been formulated and extensive work is being done to put these standards in final shape for official promulgation. Throughout the year investigations have been made regarding the practice of sulphuring oats on a commercial scale, which have demonstrated the fact that sulphuring materially reduces the germinating power of the grain. It has been ascertained that a considerable percentage of oats which are being bought for seed have been subjected to this injurious process.

The rice standardization investigations have been continued along lines similar to those laid down in the preceding year, with the exception that the field of investigation has been extended to include the rice producing and milling centers of the State of California. Special attention has been given to methods of harvesting, handling, storing, and grading rice, especially those factors which are of most importance in grading rough and milled rice, with a view to establishing definite grades.

Investigations of the handling, storing, and grading of barley, grain sorghums, and flax are now being started in order to establish grades for those grains.

In the Pacific Northwest definite and valuable results have been attained in promoting the practice of handling grain in bulk instead of in sacks. Expert assistance has been given in constructing granaries and elevators, and about 100 country elevators have been built, mostly by farmers' cooperative organizations, according to the bureau's recommendations. Assistance also was given in planning the million-bushel terminal elevator erected by the municipality at Portland, Oregon.

A study was made of the quality and condition of the Australian wheat now being imported into the United States, an investigator having gone to Australia to study the methods of handling, storing, and marketing employed in that country. The milling and baking qualities of Australian wheat also were made the subject of investigation.

Data have been collected showing the total grain storage, milling, and drying capacity of the United States.

RURAL COOPERATION.

This work is divided into two projects, both of which are under the supervision of Mr. C. W. Thompson.

RURAL CREDITS, INSURANCE, AND COMMUNICATION.

Study has been made of the operation of credit unions among farmers, the facilities for financing the live-stock business, the Torrens system of land-title registration, and the credit needs of farmers in the drought-stricken areas west of the Mississippi River. A statement regarding the matter last named was published in the Federal Reserve Bulletin of December 31, 1917. Forms of credit statements were prepared for use by bankers in connection with short-time farm loans, and a special memorandum on the subject of farmers' credit statements, prepared by this bureau, has been brought to the attention of the Federal reserve banks by the Federal Reserve Board. The department has cooperated with the Federal Farm Loan Board in disseminating information regarding loan accommodations through Federal land banks. A comprehensive investigation regarding current interest rates paid on long and short time farm loans in the United States has been started.

A publication has been issued containing a suggested law providing for the operation of credit associations and credit unions.

Field studies of various types of farmers' mutual insurance companies have been continued. A digest has been made of the State laws relating to such companies, and a model State law regulating the operation of such organizations has been prepared in tentative form. A system of accounts for farmers' mutual fire insurance companies has been prepared.

Studies of local telephone companies and systems have been made in 20 States.

RURAL SOCIAL AND EDUCATIONAL ACTIVITIES.

Studies have been made of farmers' associations formed for social and educational improvement, and an investigation is under way regarding the conduct of extension and demonstration work through such organizations. Information has been obtained concerning the financing, maintenance, and management of 110 community buildings. A list of more than 300 community buildings has been secured, and a questionnaire is being sent to all of these in order to obtain uniform detailed information on important points. A list of the State, county, and community fairs held in the United States has been completed, and study of women's rural organizations has been continued.

COOPERATION WITH STATES IN MARKETING WORK.

During the fiscal year 1918 work in marketing and rural organization was conducted in cooperation with 27 of the 48 States. Work in each State was under the immediate direction of a field agent in marketing, stationed in the State, his function being to assist in coordinating its marketing and rural-organization activities. Mr. J. C. Skinner represents the Bureau of Markets in the administrative supervision of this work.

In the States in which agents were stationed, careful study was made of local marketing problems, existing marketing machinery, transportation facilities, and marketing outlets. Assistance was given in cooperative organization work and in the marketing of various commodities, and extension work was done to bring to producers and others the results of work of the Bureau of Markets and the State agencies cooperating. Heavy demands were made upon the time of the field agents in marketing by officials of the Food Administration and the State Councils of Defense. They were called upon by these authorities to render much assistance and service, and in many instances devised and put into operation plans that resulted in the more prompt, economical, and profitable movement of important crops under emergency conditions. In several instances their work resulted in relieving grave situations and enabled food crops to be handled so as to prevent serious loss.

The States in which cooperative work was conducted were: Arizona, Arkansas, Colorado, Connecticut, Georgia, Indiana, Iowa, Kentucky, Louisiana, Massachusetts, Michigan, Minnesota, Mississippi, Montana, Nebraska, New Mexico, North Carolina, North Dakota, Oklahoma, Oregon, South Carolina, Tennessee, Texas, Utah, Vermont, Virginia, and Washington.

SERVICE WORK.

MARKET NEWS SERVICES

The market news services of this bureau perform a highly useful, if not indispensable, function in assisting in the marketing of the various products regarding which reports are issued. The news service on fruits and vegetables has been greatly expanded with emergency funds. This is also true of the market news service on live stock and meats. The services on dairy and poultry products, grain, hay, and milled feeds, and seed are entirely supported by emergency funds since they were instituted as emergency measures. Producers, distributors, and others have come to depend almost entirely upon these services for their market information, and this work has caused the disuse of many commercial price-quoting agencies not able to furnish information so reliable, accurate, prompt, and comprehensive. The daily telegraphic reports issued in connection with the bureau's news services are transmitted largely over its leased wires, which extend approximately 15,000 miles.

MARKET NEWS SERVICE ON FRUITS AND VEGETABLES.

This work, which is under the direction of Mr. W. A. Sherman, has been greatly expanded since war with Germany was declared. Reports have been issued in season covering approximately 32 commodities. These reports give information regarding daily car-lot

shipments, the jobbing prices in the principal markets throughout the country, prices, and other shipping-point information on the more important crops, as follows:

Apples.	Grapefruit.	Plums.
Asparagus.	Grapes.	Prunes.
Bunched vegetables.	Green peas.	Spinach.
Cabbage.	Honey (semimonthly).	Strawberries.
Celery.	Lettuce.	String beans.
Cherries.	Mixed fruit.	Sweet potatoes.
Cantaloupes.	Onions.	Tangerines.
Cranberries.	Oranges.	Tomatoes.
Cucumbers.	Peaches.	Watermelons.
Dry beans.	Pears.	White potatoes.
Eggplant.	Peppers.	

The number of permanent market stations was increased during the past fiscal year from 12 to 32. These stations, completely equipped, have been issuing daily reports continuously since the date of their opening. In other words, the market news service on fruits and vegetables has been made continuous throughout the year for the first time since its inception. During previous years the service extended over periods varying from seven to nine months. The market stations in operation at the opening of the fiscal year were located in Baltimore, Boston, Buffalo, Chicago, Cincinnati, Denver, Kansas City, Minneapolis, New York, Philadelphia, Pittsburgh, and St. Louis. Twenty additional permanent stations were opened during the year in the following cities: Atlanta, Cleveland, Detroit, Fort Worth, Columbus, Memphis, Omaha, Birmingham, New Orleans, Jacksonville, Indianapolis, Des Moines, Houston, Oklahoma City, Portland, San Francisco, Spokane, Fargo, Los Angeles, and Butte.

During the calendar year 1917 temporary field stations were operated at 82 points in various producing sections during the period of important crop movements. More than twice as many stations of this kind were opened as in the preceding year.

During the calendar year 1917 approximately 10,099,643 complete daily reports were issued from market and field stations. About 90,000 individuals requested and received these reports. From January to June, 1918, more than 10,000,000 reports were distributed from market and field stations.

By arrangement reports have been issued regarding local receipts and local market prices in certain cities not yet covered by the agents of the "City Market Service" described hereinafter. This information is published in daily, or bi-daily, reports for the benefit of consumers, hotels, restaurants, and stores.

The rapid but substantial development of the market news service on fruits and vegetables has necessitated for administrative purposes the division of the country into three districts, the Mississippi River and the Rocky Mountains being the general dividing lines. The eastern portion of the country is supervised from Washington, and district supervisors have been appointed for the other two sections. This districting has resulted in increased efficiency and better service.

In addition to the daily market news reports on fruits and vegetables a special "Weekly Review" is issued showing the trends and tendencies in the principal markets. This Review is based on the daily reports of market prices and on the "Weekly Summary of Carlot Shipments," which is compiled from the daily reports of more

than 500 carriers. The "Weekly Review" is published in agricultural and trade papers. Through the market stations, about 5,700 copies are distributed to dealers, producers, and other interested persons. A special edition is prepared for papers which go to press late in the week, and plans are being laid to publish editions adapted particularly to the various geographical divisions of the country.

HONEY REPORTS.

In the shipping season semi-monthly honey reports are issued to some 1,200 interested persons, showing the market conditions governing the sale of this commodity.

MARKET NEWS SERVICE ON LIVE STOCK AND MEATS.

The market news service on live stock and meats, which is conducted under the direction of Mr. L. D. Hall, has been materially expanded by the use of emergency funds provided under the food production act. Before these funds were available branch offices had been established in Boston, New York, Philadelphia, Chicago, Kansas City, Omaha, and Washington. These funds made it possible to provide for necessary increases in the forces at these offices, to extend the leased wire service, and to maintain offices at Fort Worth, Portland, Oreg., Lancaster, Pa., Rocky Ford, Colo., St. Paul, Los Angeles, Denver, Salt Lake City, National Stocks Yards, Ill., Pittsburgh, and Louisville.

The daily reports on meat-trade conditions, which formerly gave information regarding the demand, supplies, and wholesale prices of western dressed fresh meats at Boston, New York, Philadelphia, and Washington, were extended to include similar information on conditions in Los Angeles and Pittsburgh. As a supplement to the daily reports, a weekly review is now published. The latter is distributed on Saturday mornings and provides an index to the week's trend of meat movements and prices, being used particularly by wholesale and retail dealers and by live-stock commission men. Approximately 1,750,000 copies of the daily report and 400,000 copies of the weekly report were distributed during the past year.

The daily telegraphic reports made by railroad division superintendents, showing the number, State origins, and destinations of single and double deck cars of each class of live stock loaded west of the Allegheny Mountains during the preceding 24 hours were commenced on July 31, 1917. By use of emergency funds this service has been improved, and on January 1, 1918, was extended to include all loadings on railroads throughout the United States.

The work of reporting receipts and shipments of live stock at stockyards was expanded to include figures on local slaughter. Officials of 85 stockyard companies now transmit monthly reports to this bureau, which reports show receipts, shipment, and slaughter of live stock at their yards. In addition officials of 45 of these yards report monthly the number of stockers and feeders shipped or driven out to feeding districts. Approximately 16,000 copies of this report, with a summary showing totals and comparisons, are distributed about the tenth of each month. A preliminary report on receipts at the larger markets is issued about the third of each month.

During the year local representatives stationed at Lancaster, Pa., and Rocky Ford, Colo., collected information on the "in" and "out" movement of live stock in the Lancaster and Arkansas Valley feeding districts. This information, which is extremely valuable in indicating the potential meat supply, was published in the mimeographed weekly sheet entitled "Live Stock and Meat Trade News," issued by the bureau. This bulletin publishes items of interest to the live-stock and meat trade and is used very extensively by local papers and individuals throughout the country. It has proved to be one of the most useful reports issued by this project. Approximately 340,000 copies were distributed during the year.

At the urgent request of the live-stock trade and of stockmen, both through their organizations and individually, this bureau, on June 1, 1918, took over the work of furnishing all telegraphic market reports on live-stock receipts and prices which are distributed daily from the Chicago Union Stock Yards, including not only the reports regularly sent over the leased wire of the Bureau of Markets but all reports used by the commercial news agencies and press associations. This service consists of a series of four reports furnished to the telegraph companies at different hours of each market day; two additional reports, which are sent to those cities reached by the bureau's leased wires; and two reports which are furnished to the press associations for the daily papers. The early reports give the estimated receipts and the later reports the market conditions and prices on all classes of live stock. At those markets in which the bureau maintains local offices, these reports are posted on bulletin boards and are made available to anyone who calls or telephones for them. Through the commercial news departments of the telegraph companies and the press associations, this service is made available to interested persons both at market centers and country points throughout the United States.

WOOL REPORTS.

Beginning with the report of June 30, 1917 (issued July 28, 1917), reports have been issued quarterly showing the stocks of foreign and domestic wool, as well as tops and noils, segregated by classes and grades, held by manufacturers and dealers in the United States.

The first monthly report of the bureau showing the amount of wool consumed in manufacture during the preceding month was issued on February 23, 1918, showing the consumption for January, 1918, and these reports have been issued regularly since that date. The wool reports issued by the Bureau of Markets furnish the most complete and reliable information available to the public with respect to this commodity and have proved a valuable aid in conserving and utilizing the wool supply of the country to the greatest advantage in the present emergency.

REPORTS REGARDING THE SUPPLY OF ANIMAL HAIR.

At the request of the War Trade Board arrangements have been made to furnish periodical reports regarding the stocks of animal hair held by dealers and manufacturers. Schedules were sent to approximately 7,000 firms, requesting reports of stocks on hand June 30, 1918. These data will be published at an early date.

MARKET NEWS SERVICE ON DAIRY AND POULTRY PRODUCTS.

This news service, which is under the supervision of Mr. R. C. Potts, is financed entirely by emergency funds, having been instituted in the fall of 1918 under the Food Production Act.

Reports are issued monthly to show the production of dairy products, the data for which are secured from approximately 14,000 dairy manufacturing plants in the United States. These reports show the amounts of the various manufactured creamery products, such as whey, process butter, oleomargarine, cheese of various classes, condensed and evaporated milk, various classes of powdered milk, casein, milk sugar, etc. They have been issued monthly since September 1, 1917, and furnish an accurate and comprehensive view of the dairy production of each State and of the country as a whole. These reports have been used by various governmental agencies, including the War Trade Board, United States Shipping Board, United States Food Administration, and others. They have been given very wide distribution through branch offices of this bureau and the dairy journals to which they are furnished.

Daily market reports on butter, eggs, and cheese have been issued since the fall of 1917 from Washington, Boston, New York, Philadelphia, Chicago, Minneapolis, and San Francisco, in which cities this project has branch offices. These reports supply information regarding prices, trade conditions, market receipts, storage movement, supplies in storage, and supplies in the hands of wholesalers and jobbers. The mailing list of those receiving these reports has constantly increased, and at the close of the fiscal year about 7,500 copies were issued daily. It is generally conceded that the accurate and reliable information thus issued has been of great aid in stabilizing the market, in eliminating speculation, and in bringing about greater economy and efficiency in the marketing of these products.

MARKET NEWS SERVICE ON GRAIN, HAY, AND FEEDS.

This news service, which is under the general supervision of Mr. George Livingston and was under the immediate direction of Mr. K. B. Seeds, and later of Mr. G. C. Wheeler, has been undertaken since the passage of the food production act. The machinery created for the issuance of these reports has been utilized also for emergency work of signal value, which could not have been conducted had these facilities not been available.

For the purposes of this work branch offices have been opened at the following points: New York, Richmond, Atlanta, Chicago, Minneapolis, Kansas City, Oklahoma City, Denver, Spokane, and San Francisco.

As rapidly as the local organizations could be completed, these offices began to issue bi-weekly reports which contained statistical information regarding stocks of grain, hay, and feed, the supply of and demand for these commodities, and the prices at which they were being bought and sold in carload lots, compiled from reports obtained from voluntary correspondents. Weekly news letters have been issued regarding the general market conditions in the principal markets for these commodities. Special surveys have been made from time to time covering particular phases connected with the

sale of such products, and reports, based on these surveys, have been issued as seemed advisable.

During the year emergency offices were opened at Fort Worth, Tex., for about six months, and at Bismark, N. Dak., for one month to assist in securing supplies of feed for cattle raisers and farmers in drought-stricken areas. This work was helpful in saving thousands of cattle from starvation.

At the request of the Railroad Administration a survey was made in February to obtain specific information relative to the location and quantity of soft corn ready for shipment. This information was used by the Director General of Railroads when distributing cars in the soft-corn territory.

At the request of the Food Administration, surveys were made to determine the supplies of feedstuffs in the North Atlantic States and the supplies of field peas in the Southeastern States.

SEED REPORTING SERVICE.

The market news service on seeds is financed entirely from emergency funds and has been organized under the direction of Mr. W. A. Wheeler. Field offices have been established in Chicago, Minneapolis, Kansas City, Atlanta, Spokane, San Francisco, and Denver, each in charge of a representative who obtains timely information on seed crops, movement, and supplies. This information is summarized before being sent to Washington, where it is revised and published in the "Seed Reporter" or in special mimeographed reports.

A preliminary vegetable seed survey and a clover and alfalfa seed survey were made in November, 1917. Two regular semiannual field and vegetable seed surveys were conducted, the first under date of January 31, 1918, and the second under date of July 1, 1918. Through these surveys a comprehensive inventory was made of the seed stocks of the country, and the relative available stocks of seeds last year and this year. On July 1, 1918, a special survey of vegetable seed production was made.

The Seed Reporting Service cooperates with the Department Seed Stocks Committee in furthering effective seed distribution, and whenever needed, the facilities of the field offices have been placed at the service of the Seed Stocks Committee. Assistance was rendered in finding lots of wheat and rye in the Northeast and in judging their suitability for seed. Assistance also was rendered in purchasing and distributing seed in the drought-stricken areas of Montana and North Dakota.

Information is furnished to the War Trade Board in order to assist that body in controlling export licenses for seeds. Special assistance was given in providing for Canada's requirements of seed ensilage corn, seed sweet corn, and red-clover seed.

The information obtained in connection with the conduct of this service is published in the "Seed Reporter," which is a publication of from four to eight pages and is issued monthly, or oftener if it seems desirable. It is sent to a regular mailing list of approximately 17,500 names including those of dealers, growers, and shippers, and State and Federal agencies.

Special mimeographed reports are issued at weekly intervals, or oftener when emergencies arise that demand special consideration.

Last spring when it was apparent that much difficulty would be encountered in finding plenty of good seed corn, weekly seed-corn reports were issued from the Chicago, Minneapolis, and Kansas City offices for the territory surrounding them.

CITY MARKET SERVICE.

The City Market Service, which is under the supervision of Mr. G. V. Branch, was started in Providence, R. I., shortly before the beginning of the last fiscal year, where it has developed into a most useful service. As a result of this successful experiment, this work was broadened by the use of emergency funds and agents were placed in 15 additional cities. The 16 cities in which the service has been installed are Providence, R. I.; Boston, Springfield, Worcester, and Lawrence, Mass.; New Haven, Bridgeport, and Hartford, Conn.; Albany, N. Y.; Cleveland, Ohio; Grand Rapids, Mich.; Chicago, Ill.; St. Paul, Minn.; St. Louis, Mo.; Denver, Colo., and Washington, D. C. In all of the cities except Grand Rapids and Albany it is now in operation and has proved to be of value both to producers and consumers. In practically all cases cooperating agencies pay a portion of the expenses of the service, which consists largely of reports on local market conditions based on daily observation. These are issued primarily for the benefit of growers and consumers, though the special reports for growers are very useful to dealers also.

Consumers' reports are made public through the local newspapers. Care is taken to avoid all technical expressions, and constant endeavor is made to see that the reports are interesting and constitute helpful guides for the housewife in buying fresh fruits and vegetables. The reports classify the products each day under the headings, "abundant," "normal," and "scarce"; discuss any market matters of interest to consumers, including the best times for canning, preserving, etc., and furnish a list of prices showing what retail dealers are paying for various products. Quotations are made on the units by which housewives buy so that they furnish a valuable check to consumers regarding the prices charged by retailers. In a few cities, through cooperation with the Federal or local food administrators, a fair-price list is published in connection with these reports.

The growers' reports, as prepared in most of the cities, are distributed to growers each day at the farmers' markets or mailed to their farms. After a brief discussion of market features, changes, developments, etc., the reports give tables showing prices received by growers for various products and prices received by wholesale and commission dealers. The latter prices are given separately for both local and shipped-in produce. These reports also show car-lot arrivals of certain products on the day of issue and the total number of unbroken and broken cars on local tracks. The growers' reports give farmers their first reliable market information and enable them to adapt their marketing procedure to actual conditions. Basing their judgment on the recorded conditions of the day before and their own observation of the current day, they are able to make an intelligent estimate of fair prices much more quickly than when no market reports are available. Growers not going to market daily are kept in touch with market conditions and thus learn when it is advantageous to market certain products. Farmers marketing their

produce through commission dealers find the reports useful as a means of checking statements of sales.

The operation of this service has a marked tendency to decrease market gluts by increasing the consumption of abundant products, and in the various cities in which the Local Market Reporting Service has been established, it has received the hearty commendation of producers and consumers, especially civic leaders and domestic economy workers.

In addition to carrying on the regular work of this service the agents in a number of cities have also been able to bring about special improvements in marketing conditions.

EMERGENCY TRAFFIC AND STORAGE ASSISTANCE.

Abnormal transportation conditions engendered by the war have caused the receipt by the Department of Agriculture of a flood of complaints and appeals for assistance in obtaining transportation facilities from producers and distributors of agricultural products, and from the manufacturers, distributors, and users of the commodities needed in agricultural production. All of this correspondence reaching any bureau or division of the Department of Agriculture has been referred to the Transportation Division, which is under the direction of Mr. G. C. White, and much work has been done in relieving many urgent cases.

Transportation men have been detailed to heavy producing sections to work in close cooperation with shippers and carriers in an effort to procure better service for shippers and to avert shortages of cars and ice for refrigeration in transit, by bringing about the best possible utilization of equipment and by heavier and better loading, etc. Work of this kind was taken up in connection with the movement of the onion crop of Texas and the cantaloupes of the Imperial Valley of California and the Salt River section of Arizona.

The cold-storage specialists of the Bureau of Markets have cooperated with representatives of the United States Food Administration in formulating regulations governing the distribution and marketing of cold-storage foodstuffs. Assistance has been rendered to the Quartermaster Corps of the United States Army in planning better methods of handling and conserving, in storage and in transit, the meat products intended for the Army abroad.

FOOD PRODUCTS INSPECTION SERVICE.

Under authority contained in the food production act, which authorized the Secretary of Agriculture to investigate and certify to shippers the condition as to soundness of fruits and vegetables received at important central markets, the Food Products Inspection Service was instituted during the last year in 36 of the most important markets of the country. For administrative purposes the country was divided into four divisions, each in charge of a supervising inspector. The headquarters of these divisions are Washington, New York, Chicago, and Los Angeles. This work is supervised by Messrs. W. M. Scott and C. T. More.

Rules and regulations for the conduct of this service were contained in Circular 82 of the Secretary's Office, and information concerning

the service was given in Service and Regulatory Announcements No. 28 of the Bureau of Markets.

The services of the inspectors have been used extensively by the United States Food Administration and its State and local administrators, and by the Army and Navy in connection with the purchase of supplies. The value of the service has been generally recognized by various officials and officers. The certificates issued by inspectors have been used as a basis for the settlement of the damage claims of shippers and receivers.

This service has had a beneficial effect in speeding up the movement of perishable foodstuffs, because, owing to its operation, it has been possible to release cars more promptly and to prevent a large number of rejections and diversions. Although it is new, and for that reason has not been fully utilized by those to whom it is available, it already has received widespread and cordial indorsement from shippers and receivers, transportation companies, and others interested in the distribution and marketing of farm products.

MOTOR-TRUCK SERVICE WORK.

In view of the difficulties which probably will be encountered in important shipping sections during the period of heaviest crop movement, it has seemed desirable to institute an experimental motor-truck service to supplement existing transportation facilities. Because of the difficulty of obtaining experienced men, this work has been confined thus far to New Jersey, western New York, and northern Ohio. A complete survey has been made in each of these districts to ascertain their trucking facilities, and arrangements have been made whereby motor trucks can be placed in producing districts during periods of heavy crop movement, in order to facilitate the rapid transportation of farm products to market. Lists of available motor trucks are on file in Philadelphia, Buffalo, and Cleveland, and over 200 motor-truck operators have listed their trucks with the bureau's Philadelphia office alone. Trucks have been diverted to producing districts for short periods, but it is not expected that the valuable features of this work will become readily apparent to producers until the heavy crop movement takes place later in the season. This work has developed from the investigational work regarding motor-truck marketing described elsewhere in this report. Like those investigations, it is under the direction of Mr. J. H. Collins.

COLD-STORAGE REPORTS.

The cold-storage reports issued by the bureau have been much expanded and now include data for 44 commodities. These reports are issued monthly or oftener and are based on information received from 1,310 cold-storage plants and meat-packing establishments, practically all of those in existence in the United States. The primary commodities now being reported upon are apples, butter, cheese, eggs, fish, lard, meats, and dressed poultry. The authority contained in the food production act has greatly facilitated the department's work in securing these reports.

PURCHASE AND DISTRIBUTION OF NITRATE OF SODA.

Section 27 of the food control act authorized the President to procure and sell nitrate of soda to farmers at cost, for the purpose of increasing production, and appropriated \$10,000,000 for that purpose. By direction of the President, the War Industries Board made arrangements for the purchase of the nitrate, and the Secretary of Agriculture made arrangements for its sale and distribution, designating the Bureau of Markets as the agency through which the work was to be handled. Messrs. D. F. Murph and George R. Argo have given a great deal of time to this work, while remaining in charge of the projects which they regularly supervise.

Contracts were made for the purchase of about 120,000 short tons and arrangements were effected to secure, through the Shipping Board, tonnage for transporting the nitrate from Chile to this country. Early in the year 1918, effort was made to estimate the cost of the nitrate, and as a result the price was established at \$75.50 f. o. b. cars at port of arrival, which price was announced in January, 1918. Farmers were given an opportunity to make applications for nitrate through county agricultural agents and committees of local business men appointed for the purpose. Applications were received for more than 120,000 tons, the total quantity purchased. About 75,000 farmers submitted applications for quantities ranging from one-tenth of a ton to more than 100 tons. On account of the lack of available shipping it was possible to bring in, up to June 30, 1918, only about 75,000 tons. Practically all of this nitrate actually had been shipped to farmers by June 30.

Some of the nitrate was consigned directly to farmers, but the greater part was consigned to county distributors in the various counties. It became evident early in the year that on account of the lack of vessels, sufficient nitrate would not arrive in time to make complete delivery during the period of greatest need. Consequently, in order to make the quickest and most equitable distribution possible, and to save to farmers the interest on deposits required to be made in payment for nitrate, there was appointed in each of a number of counties requiring a large quantity of nitrate, a county distributor to whom shipments for the county were made, on sight draft with bill of lading attached, and by whom distribution was made to the farmers.

A ship with a capacity of about 7,700 tons, which had been assigned to transport nitrate for this department, was wrecked on the coast of Chile, though, as she was not loaded, no nitrate was lost. Another ship, with a cargo of about 5,700 tons, went ashore on the coast of Cuba, and was so badly damaged that most of her cargo was lost.

On June 30 there remained in Chile between 39,000 and 40,000 short tons of nitrate for which the department had been unable to secure transportation to this country from the Shipping Board.

REGULATORY WORK.

ENFORCEMENT OF THE UNITED STATES COTTON FUTURES ACT.

The general administrative work connected with the enforcement of the cotton futures act is under the direct supervision of the Chief of the Bureau, assisted by Mr. D. S. Murph. The enforcement of the act is carried out under the following projects:

INVESTIGATIONS OF FUTURE AND SPOT MARKETS.

These investigations are directed by Mr. George R. Argo, who also is in charge of the project "Determination of Disputes." It has been very difficult to obtain correct commercial differences for cotton during the past season, owing to the abnormal demand for high-grade cotton and the practical unsalability of low-grade cotton. To add to the difficulty, the low grades have been concentrated in a limited number of markets which endeavored to quote them correctly, while other markets, holding no low-grade cotton, were at a loss as to how to arrive at correct differences. The result was that some markets quoted the very low grades at a much wider discount than others. Apparently the result was that the average differences for low grades were comparatively so narrow as to make delivery of low-grade cotton on future contracts quite profitable. The parity between spots and futures was fairly well maintained up to about April 10, at which time a decline in futures began and continued for several weeks. It would appear that the lack of demand and unsalability of low-grade cotton became apparent to the general trade at this time and the contract market was the only outlet. In consequence, over 20,000 bales were delivered during the month of May, and its sale was evidently found to be profitable even at the great disparity between spots and futures. This cotton was probably hedged before the decline started. Differences were widened appreciably during May and June and the disparity between spots and futures is still abnormally great.

The bureau has enjoyed the cordial cooperation of the designated spot markets throughout the year. Boston was taken from the list of spot markets on June 8, 1918, because, owing to the lack of variety in the grades received there, it was impossible to secure enough quotations to arrive at correct differences.

DETERMINATION OF DISPUTES.

The number of disputes and bales of cotton involved therein received during the last fiscal year varied from the preceding year only slightly. In 1918, 146 disputes, involving 6,895 bales of cotton were received, in comparison with 155 disputes, involving 5,903 bales, in 1917.

One dispute, involving 16 bales, was withdrawn and the deposit was returned to the complainant. The total sum collected as costs for determination of the disputes was \$2,202.30 in 1918, as against \$1,664.35 last year. All of this fund was covered into the Treasury of the United States, in accordance with the provisions of the cotton futures act.

A great deal of low-grade cotton was delivered on contract during the months of May and early June and caused many appeals to be made to this department. Out of 52 disputes, referred in this time, involving 3,156 bales of cotton, 2,404 bales, or 76 per cent, were rejected as undeliverable on contract.

PREPARATION AND DISTRIBUTION OF OFFICIAL COTTON STANDARDS OF THE UNITED STATES.

Since the establishment and promulgation on December 15, 1914, of the official cotton standards of the United States for white cotton, and on January 28, 1915, of standards for colored cotton, a total

of 943 full white sets, 155 fractional white sets, 102 full colored sets, and 36 fractional colored sets had been shipped up to June 30, 1918.

During the past fiscal year sets have been shipped as follows: Ninety full white, 34 fractional white, 26 full colored, and 28 fractional colored. A total of \$2,495.50 was covered into the Treasury from the sale and revision of standards, and \$23,109.04 was received from the sale of rejected cotton.

During April and May, an inspection was made in order to determine the condition of the official sets held by the designated spot markets.

After grade standards for American Egyptian and Sea Island cotton were formulated, 50 sets were prepared and will be distributed as soon as the standards are officially promulgated.

This work is directed by Mr. Fred Taylor.

UNITED STATES GRAIN STANDARDS ACT.

The enforcement of the provisions of this act has been continued under the direction of the chief of the bureau, assisted by Mr. George Livingston. Standards for wheat were put into effect at the beginning of the fiscal year and have resulted in a very great increase in the work to be performed under this act. While no new supervision offices have been established, the offices in the large grain markets have been expanded and the force in each has been increased.

The grain trade of the country has been very vitally affected by war conditions during the past year, and the Federal control exercised over the wheat crop has brought about conditions which have made it necessary to maintain close cooperation with the Grain Corporation of the Food Administration. The prices fixed for wheat are based upon the standards established by this department, and this has resulted in the use of these standards in practically all sales of wheat, whether moving in interstate or intrastate commerce.

Much inspection work has been done for the zone agents of the Grain Corporation and cooperative work has been done with the War Trade Board in connection with the movement of corn to Canada. Under arrangement with this body, corn was shipped to Canada under licenses, accompanied by inspection certificates indicating the grade of the corn. This was done to protect the farmers of the United States against a shortage of seed corn.

The establishment of fixed prices for the 1917 wheat crop and the elimination of competition in wheat brought about entirely new conditions for the producer and the grain trade. The Federal wheat grades, upon which the fixed prices were based, had been made effective a very short time before the fixed prices went into effect, and the radically changed conditions brought up questions as to whether the standards were adequate to the needs of the trade under fixed prices. Suggestions as to revisions of the standards, therefore, were invited from producers, country shippers, country elevators, grain dealers, and all other grain interests. Twenty-two public hearings were held to secure at first hand the ideas of all branches of the grain trade, and, as a result, a revision of both the wheat and corn standards was promulgated by the Secretary of Agriculture on April 13, 1918, and became effective as revised on July 15, 1918. The department changed these standards only after careful and unbiased consideration of a vast amount of evidence, being guided

also by its own extensive experience gained in supervision work. Some changes, also, have been made in the rules and regulations under which the act is enforced.

SUPERVISION OF INSPECTION.

The actual supervision of the inspection and grading of grain performed by inspectors licensed under the provisions of the act is carried on through 35 offices of Federal Grain Supervision located at points accessible to the great grain markets of the country. Through these offices compliance with the provisions of the act by shippers is insured, and the work of licensed inspectors at different inspection points is checked for accuracy.

The experience of this bureau demonstrated the necessity for devising a plan to secure uniformity of inspection in the various markets and such a plan was made effective in April, 1918. Steps are taken to ascertain, by a system of monthly reports, the degree of accuracy with which the grain standards are applied by licensed inspectors. In order to secure uniformity the several districts of Federal Grain Supervision which include markets handling grain of similar kinds and classes have been grouped into divisions (six in number), and a competent supervisor has been assigned to each division.

A series of meetings was held at 36 markets, in the course of which representative committees of the principal grain exchanges in the United States conferred with representatives of the bureau. As a result a permanent committee of each exchange has been appointed to deal with the Bureau of Markets in all matters pertaining to the enforcement of the grain standards act. This should insure close cooperation with the grain trade.

INVESTIGATION OF CASES INVOLVING VIOLATIONS OF THE ACT AND COMPLAINTS AGAINST THE WORK OF LICENSED INSPECTORS.

Investigations were made of 17 cases of apparent violations of section 4 of the act regarding the shipment of grain without inspection; 13 cases involving improper representation as to grade of grain under section 5; 11 cases of misgrading grain under the provisions of section 6; 8 cases of apparent violations of section 7; 18 cases involving action against licensed inspectors; 1 case involving apparent violation of section 9, in improperly influencing a licensed inspector; and 1 case involving a violation of section 10.

During the year 50 examinations were held of persons desiring licenses, 5 of whom were refused licenses. A total of 374 licenses were issued, and 261 were superseded by others.

APPEALS AND DISPUTES AND INSPECTION PROCEDURE.

In the fiscal year ending June 30, 1918, 1,457 appeals and 12 disputes were filed with the offices of Federal Grain Supervision. Sixty-nine appeals were dismissed for lack of jurisdiction and 1,388 were entertained, of which 766 were sustained.

Assistance has been rendered to licensed grain inspectors and to members of the grain trade in order to bring about the correct application of the official grain standards and the employment of proper methods of procedure in sampling, testing, and grading grain.

Laboratory methods employed in the offices of Federal Grain Supervision have been improved and standardized and additional laboratory equipment, including improved analysis tables and grain probes, has been installed.

During the fiscal year 1918, a total of 6,433 wheat and corn samples received from the 35 offices of Federal Grain Supervision were reviewed at Washington, D. C., to determine the accuracy of analysis, classification, and grading by licensed inspectors. Where corrections were necessary they were made and the samples were returned to the office from which received.

Eighty sets of types of corn were prepared, showing various degrees of damage and of color, 240 sets of types of wheat showing various degrees of damage, color, and texture, and 40 sets, each containing 49 varieties of wheat. These sets were distributed among the various field offices and have been found very useful in promoting uniformity of classification.

ADMINISTRATION OF THE UNITED STATES WAREHOUSE ACT.

During the fiscal year ending June 30, 1918, much progress was made in the investigations necessary as a preliminary to the administration of the United States warehouse act. Conditions governing the storage of cotton, tobacco, and grains were studied and lists of warehouses available for the storage of such products were compiled. Much information has been obtained regarding storage capacities and construction of warehouses, and the business methods, insurance rates, charges, and forms of warehouse receipts employed by warehouse managers and operators. These investigations were conducted in connection with those mentioned under "Cotton Warehousing Investigations."

Rules and regulations have been made to govern the procedure of cotton warehouses licensed under the warehouse act, and the necessary forms of application for licenses have been distributed on request. Numerous inquiries regarding the act have been received from warehousemen and others and it is expected that licenses will be issued in the immediate future. Tentative regulations also have been prepared covering the operation of tobacco and grain warehouses and considerable progress has been made with investigations preliminary to the establishment of tobacco standards. Investigational work with reference to the storage of wool also has been commenced.

The administration of the warehouse act is supervised by Messrs. D. S. Murph and R. L. Nixon.

ENFORCEMENT OF THE UNITED STATES STANDARD CONTAINER ACT.

The enforcement of the United States standard container act, which became effective November 1, 1917, is supervised by Messrs. W. M. Scott and C. T. More, assisted by Mr. F. P. Downing. The requirements of this act have been such as to reduce considerably the diversity of fruit and vegetable containers formerly used, and have brought about the standardization of several important shipping packages, including climax baskets, berry boxes, repacking tills, and four-basket peach and tomato baskets, and the six-basket carrier tills. Except in a few cases where manufacturers and shippers were over-

stocked with nonstandard packages, the law has met little or no opposition. During the year the stocks of over 30 package factories were inspected and the owners of those factories which were manufacturing baskets not meeting standard requirements, were instructed to make such changes in their products as would enable them to comply with the law.

REGULATION OF STOCKYARDS AND LIVE-STOCK DEALERS.

A proclamation was issued by the President on June 18, 1918, requiring all stockyards which are operated for compensation or profit and all persons handling or dealing in live or dead stock in or in connection with such stockyards, to secure a license from the Secretary of Agriculture on or before July 25, 1918. The Chief of the Bureau of Markets was designated by the Secretary to administer the supervision of licensees under this proclamation. Mr. L. D. Hall is the chief's immediate representative in this control work.

The preparation of forms of license and forms of application therefor was begun immediately upon the issuance of the President's proclamation. License application forms, together with a letter of instructions, were distributed to interested persons. A preliminary draft of proposed regulations governing licensees was prepared and copies were distributed to about 4,000 members of the live-stock trade, including stock growers and feeders, commission men, order buyers, traders and packers, with a request for their written suggestions. Conferences also were held with representatives of all the principal live-stock interests concerned. The numerous suggestions thus received were embodied in the general regulations which were signed by the President and issued by the Department on July 26, 1918, as Office of the Secretary Circular No. 116.

Plans for the organization of a force of market supervisors were drawn up and approved, and the nucleus of such a force has been formed.

PUBLICATIONS DURING THE YEAR.

DEPARTMENT BULLETINS.

- 541. Cooperative Organization By-Laws. By C. E. Bassett and O. B. Jesness.
- 547. Cooperative Purchasing and Marketing Organizations Among Farmers in the United States. By O. B. Jesness and W. H. Kerr.
- 558. Marketing Grain at Country Points. By George Livingston and K. B. Seeds.
- 559. Accounting Records for Country Creameries. By J. R. Humphrey and G. A. Nahstoll.
- 574. The Conversion of the Weights of Mechanical Separations of Corn, Wheat, and Other Grains into Percentages. By E. G. Boerner. (In cooperation with Bureau of Plant Industry.)
- 579. Celery Storage Experiments. By H. C. Thompson. (In cooperation with Bureau of Plant Industry.)
- 587. Handling and Storage of Apples in the Pacific Northwest. By H. J. Ramsey, A. W. McKay, E. L. Markell, and H. S. Bird. (In cooperation with Bureau of Plant Industry.)
- 590. System of Accounting for Fruit Shipping Organizations. By G. A. Nahstoll and J. R. Humphrey.
- 591. Manufacturing Tests of the Official Cotton Standards for Grade. By W. S. Dean and Fred Taylor.
- 601. Handling and Precooling of Florida Lettuce and Celery. By H. J. Ramsey and E. L. Markell. (In cooperation with Bureau of Plant Industry.)
- 639. The Market Milk Business of Detroit, Mich., in 1915. By C. E. Clement and G. P. Warber. (In cooperation with Bureau of Animal Industry.)

- 667. Car-lot Shipments of Fruits and Vegetables in the United States in 1916. By Paul Froelich.
- 682. Study of Prices and Quality of Creamery Butter. By G. P. Warber.
- 688. Marketing Berries and Cherries by Parcel Post. By C. C. Hawbaker and C. A. Burmeister.
- 690. Marketing Practices of Wisconsin and Minnesota Creameries. By R. C. Potts. (In press.)
- 709. Reports of Storage Holdings of Certain Food Products. By J. C. Bell and I. C. Franklin. (In press.)
- 719. Women's Rural Organizations and Their Activities. By Anne M. Evans.
- 725. A Preliminary Study of the Bleaching of Oats with Sulphur Dioxid. By G. H. Baston.
- 729. Suitable Storage Conditions for Certain Perishable Food Products.
- 734. Nematode Galls as a Factor in the Marketing and Milling of Wheat. By D. A. Coleman and S. A. Regan. (In press.)

FARMERS' BULLETINS.

- 802. Classification of American Upland Cotton. By D. E. Earle and F. Taylor.
- 830. Marketing Eggs by Parcel Post. By L. B. Flohr.
- 847. Potato Storage and Storage Houses. By William Stuart. (In cooperation with Bureau of Plant Industry.)
- 870. The Community Fair. By J. S. Moran.
- 919. Application of Dockage in the Marketing of Wheat.
- 922. Parcel Post Business Methods. By C. C. Hawbaker and J. W. Law.
- 930. Marketing Butter and Cheese by Parcel Post. By L. B. Flohr and R. C. Potts.
- 979. Preparation of Strawberries for Market. By C. T. More and H. E. Truax.

YEARBOOK SEPARATES

- 726. Rest Rooms for Women in Marketing Centers. By Anne M. Evans.
- 736. Team Work Between the Farmer and His Agent. By C. E. Bassett.
- 738. Cooperative Marketing—Where? When? How? By C. E. Bassett and O. B. Jesness.
- 745. The Service of Cold Storage in the Conservation of Foodstuffs. By I. C. Franklin.

OFFICE OF THE SECRETARY CIRCULARS.

- 76. Rules and Regulations of the Secretary of Agriculture Under the United States Standard Container Act.
- 78. Method of Sale of Nitrate of Soda to Farmers by the United States Government.
- 82. Rules and Regulations of the Secretary of Agriculture Under the Food Products Inspection Law of August 10, 1917.
- 94. Regulations of the Secretary of Agriculture Under the United States Warehouse Act. Regulations for Cotton Warehouses.
- 96. Sugar Supply of the United States: Its Extent and Distribution on August 31, 1917.
- 97. The Supply of Lard in the United States: Its Extent and Distribution on August 31, 1917.
- 98. The Supply of Canned Salmon in the United States: Its Extent and Distribution on August 31, 1917.
- 99. Commercial Stocks of Miscellaneous Cereal and Vegetable Foodstuffs in the United States on August 31, 1917.
- 100. Commercial Stocks of Wheat and Flour in the United States on August 31, 1917.
- 101. Commercial Stocks of Miscellaneous Animal Food Products in the United States on August 31, 1917.
- 104. Commercial Stocks of Fertilizer and Fertilizer Materials in the United States as Reported for October 1, 1917.

MARKETS DOCUMENTS.

- 5. The Marketing of Canning Club Products. By L. B. Flohr.
- 6. Distribution and Utilization of the Garden Surplus.
- 7. Potato Grades Recommended by the United States Department of Agriculture and the United States Food Administration.
- 8. Factors in Transportation of Strawberries from the Ozark Region. By V. W. Ridley.
- 9. More Care is Needed in Handling Western Cantaloupes. By G. L. Fischer and A. E. Nelson.

10. Loading and Transporting Western Cantaloupes. By A. W. McKay.
11. A Portable Farm Granary. By L. M. Jeffers, W. J. Larkin, and A. L. Rush.
12. Grain Driers in the United States. (In press.)
13. Heavy Loading of Freight Cars in the Transportation of Northwestern Apples.
By H. J. Ramsey. (In press.)

SERVICE AND REGULATORY ANNOUNCEMENTS.

- 23-26, 29, 31-36. [Under United States Grain Standards Act.] (No. 37 in press.)
27. [Under United States Warehouse Act.]
28. [Under Food Products Inspection Law.]
30. Suggestions for an Act Providing for Cooperative Credit Associations or Credit Unions. 1918.

FOOD SURVEYS.

Vol. 1, Nos. 1-9.

SEED REPORTER.

Vol. 1, Nos. 1-9.

IN COOPERATION WITH THE STATES.

- Arizona Agricultural Experiment Station, Bulletin 85. A Study of Marketing Conditions in the Salt River Valley, Arizona. By J. H. Collins.
- Nebraska Agricultural Experiment Station, Circular 5. From Car Door to Consumer. By H. C. Filley.
- New Hampshire College of Agriculture and Mechanic Arts, Extension Bulletin 8. A Survey of the Dairy Marketing Conditions and Methods in New Hampshire. By L. M. Davis.
- Washington State College, Department of Extension, Series 1, No. 29. The Bulk Handling of Grain on Washington Farms. By Asher Hobson.



REPORT OF THE ACTING CHIEF OF THE OFFICE OF FARM MANAGEMENT.

UNITED STATES DEPARTMENT OF AGRICULTURE,
OFFICE OF FARM MANAGEMENT,
Washington, D. C., October 14, 1918.

SIR: I am submitting herewith the annual report of the Office of Farm Management for the fiscal year ended June 30, 1918.

Respectfully,

E. H. THOMSON,
Acting Chief.

Hon. D. F. HOUSTON,
Secretary of Agriculture.

The unusual conditions brought about by the war have made necessary abrupt and important changes in the management of farms in all parts of the country. These changes, in the main, have been in the nature of adjustments to meet difficulties in securing an adequate supply of farm labor and of necessary materials used in production. To the problems involved in making these adjustments the Office of Farm Management naturally has directed its major activities during the past year. Before this country became involved in the war, a number of routine farm management investigations were in progress, but these were laid aside in all cases in which it was found that those engaged in the work could be used to better advantage in work bearing more immediately upon the war emergency. Just as it was necessary to put the farm on a war basis, so the activities of the Office of Farm Management have been put on the war basis with a view to helping to solve the problems that are foremost in the minds of the farmers and most in need of attention during this crisis.

The primary problem has been to increase the production of all farm products, notwithstanding decreased facilities for production. In the face of an unusual situation it was necessary to plan a safe program in farming, one which would insure an ample supply of food products, not only for ourselves, but also for the allied powers. It was no time for experiment or untried innovations, but rather for the most efficient application of standard methods that could be depended upon to bring results.

This program demanded maximum efficiency of labor, for in most cases less labor than usual was available. In the main, this efficiency of labor could be realized only by the wider and more effective use of machinery and teams. Such use necessitated unusually careful

planning of the farm work, to eliminate idle periods as far as possible, and to insure the fullest possible utilization of all available forces of production.

Not the least of the problems to be solved was that created by the acute shortage of concentrated feeds for live stock. This shortage was especially grave in certain areas, and in many localities necessitated the complete rearrangement of farming systems to provide a larger supply of home-grown feeds, grains as well as roughage.

Obviously one of the most direct ways of increasing production is through keeping crop yields on a high level, by the skillful use of fertilizers, manures, and legumes. A more thorough study of the problems of maintaining crop yields than has yet been made is imperatively demanded by war-time conditions, and this is to-day one of the major lines of investigation that are being followed by the Office of Farm Management.

FARM-LABOR PROBLEMS.

The responsibility of handling the farm-labor problem in cooperation with the various State and governmental labor agencies was assigned to this office. Farm Help Specialists were placed in the several States to conduct educational campaigns and perform the functions of a clearing house on all problems arising out of the shortage of labor on farms. These farm-help workers cooperated with State and Federal agencies in each area, so as to insure the maximum efficiency in the conduct of the work and to avoid duplication of effort.

The work, in the main, was confined to ascertaining the farm labor needs of a community and reporting these needs to the various agencies that might be in a position to supply labor needed. Steps were also taken to develop and apply methods which would insure a more careful estimate of the actual needs of farmers in each district during rush seasons. Great difficulty has been experienced in the past in definitely determining the labor needs of any one community far enough in advance to permit planning to meet the shortage. Surveys were made in some of the grain-producing districts of Kansas and the Dakotas, and the results indicated that a fairly accurate estimate can be made of the labor needed for planting and harvesting by having at hand data on the extent and organization of the farms in any particular region.

Perhaps the greatest achievement that may be credited to the farm labor activities with which the Office of Farm Management has been concerned is the establishment of cordial cooperation and sympathetic understanding between farmers and local business men. As a result of this cooperation crops have been harvested by aid of the business men from cities and towns in hundreds of localities where large losses would undoubtedly have occurred from sheer lack of labor. About 35,000 persons were thus obtained to help harvest in Kansas, 15,000 in Nebraska, 20,000 in Oregon, 10,000 in Missouri, 12,000 in Indiana, 25,000 in Illinois, and proportionate numbers in practically all other States. The farmer has thus learned that local town and city folks can assist greatly in this emergency work and has come to look with favor upon their cooperation. The effect has been to bring farmer and town resident into a more cordial relation.

The results achieved along this line are especially helpful toward providing the harvest labor needed in a constantly enlarging agricultural program. Too much emphasis can not be placed upon the phase of the labor work that has to do with bringing into close co-operation and alignment all the forces which have more or less to do with the labor problem and framing a program that will eliminate as far as possible the loss due to having an over supply of labor at certain places and shortage at others, and that will make possible the use of all the local labor to the fullest extent and thus save transportation of workers from distant areas and necessary loss of time occasioned in such travel.

CROP ECONOMICS.

The problems of crop economics vary widely according to the region and the crops involved. The activities of the Office of Farm Management along this line for the past year have had to do with the study of farm practice in the production of sugar beets, corn and silage, wheat, rye, oats, barley, buckwheat, rice, fruits, cotton, soy beans, hay, and legumes, such as clovers and alfalfa. Attention has also been given to pastures, their importance, and the methods of making them a more effective part of the farm business.

Very extensive investigations have been made on the production of sugar beets. In the irrigated districts in the Mountain and Pacific States, also in Michigan and Ohio, farm-practice studies on this crop have been collected on over 1,500 farms. These include data on the number and extent of the operations, the equipment used, the effect of these operations upon the yields obtained, and the relationship that the sugar-beet enterprise bears to the rest of the farm business.

In the study on the production of silage, information has been obtained on the best practices and methods followed by growers in various districts, especially in the northern dairy regions; the effect of the degree of maturity on yields, the shrinkage and wastage in storage, and the feed requirements as determined through the experience of the best live-stock growers.

The investigations in the production of wheat and other small grains have had to do primarily with the place that these grains should occupy in the rotation; with farm practices with reference to weed control; with the conservation of moisture, the reduction of the amount of labor necessary in the various operations, and the elimination of waste and damage by weather and other agencies.

Studies of fruits have been confined primarily to the apple-growing districts, with a view of determining the extent of area that the orchard should occupy on a general farm, the relationship that it bears to the rest of the farm business, and the practices which make it a profitable part of the business. Data have been collected on all the operations incident to the growing of apples in each region.

The investigations of cotton have been associated with studies of the soy bean and the velvet bean with a view of working out rotations which will maintain a high level of yield in all these crops, with a minimum of labor. Soy beans and velvet beans are comparatively new crops in many parts of the South, and there has been urgent need of more information on these crops.

Investigations of hay and other forms of dry forage have been confined largely to improved methods of making hay, special attention having been given to methods which decrease man-labor requirements. A number of bulletins have been published dealing with improved methods of handling hay, especially in the South and East.

Need for greater attention to pastures is more and more apparent. Although funds have not been available for making a careful study of this problem, attention has been directed to the importance of pastures and the place that they should occupy on live-stock farms.

LIVE-STOCK ECONOMICS.

The farm-practice studies with reference to the management of live-stock farms, particularly in the corn-belt States and in the north Atlantic districts, have been continued with valuable results. Special attention has been given to the requirements in the way of feeds and labor, as worked out by experienced live-stock men in each of these districts. There is an increasing demand for information of this nature, and the farm-management studies which have been conducted along this line have been a very fruitful source of data on this subject.

Records covering a five-year period on a number of beef-cattle farms in the Central States give a very accurate index of the needs of this industry in the way of equipment, feed and labor; also give indication of the returns that can be expected in raising and in fattening beef cattle and in the production of baby beef on corn-belt farms. Attention has been directed to those factors which make the production of feeder cattle a profitable enterprise in the Middle West, a problem especially important in view of the decreasing supply of feeder cattle from the ranges and mountain regions.

Extensive studies have also been made in the practices found on farms where fattening sheep is an important enterprise. Another important problem has been in connection with determining the place which sheep should occupy on the small farms in the East and North Atlantic States. A bulletin has been published dealing with the possibilities of a revival of the sheep industry in New England.

With present prices, the question of farm equipment and power is of increasing importance, especially in view of the quite general substitution of tractors for horses, and the gain that thus may be effected through the products from land formerly required for the support of work stock. Data have been published giving the hours of labor performed by work horses as found on a number of farms in different parts of the country, and the feed requirements and labor necessary in providing for their maintenance. Such information has been exceedingly valuable in planning efficient systems of farm organization.

FARM-EQUIPMENT INVESTIGATIONS.

Under the stress of war-time conditions a more intensive utilization of all kinds of farm equipment has become necessary. The difficulties in securing labor and the increased cost of motive power make it desirable to use those machines which will effect the greatest saving in time and expense. Farm-management investigation of the economics of various kinds of machines, their cost and practicability, has been especially useful at this time.

The tractor has received a great deal of attention from farmers in most parts of the country. Continued demands have been made for information on the factors which determine whether it will pay to purchase a tractor, with special reference to size of farm business and kind of farming followed. Detailed reports on the performance and practicability of all kinds of tractors have been obtained from more than 12,000 owners of these machines. Several publications have been issued giving the latest experiences of tractor users in different parts of the country and indicating the conditions under which the purchase of a tractor is advisable and the results that may be expected from its use.

The labor situation on dairy farms has emphasized the importance of the milking machine. Very careful investigations conducted on more than 300 farms on which various types of milking machines are in use have enabled the office to answer the questions relating to this form of equipment. Particular stress has been given to such questions as the size of herd which will justify the purchase of a milking machine, the time saved through its use, the cost of its operation, and its effect, if any, upon the dairy cow.

Attention has also been directed to the care of machinery, with a view to insuring its maximum efficiency and reducing expense for repair and replacement, as well as to certain special equipment problems, such as the use and practicability of wood-sawing outfits, the use of corn-harvesting machinery, and the care and operation of thrashing machines. Particular attention has been given to the use of larger machines wherever practicable and to the introduction of new labor-saving machines in regions where man labor can be saved by their use.

FARM TENURE.

Investigations on tenure have been largely discontinued, though such data as already have been collected have been summarized and published. Attention on this subject has been directed to working out a suitable lease contract for farms of different types. More particularly, these studies pertain to dairy farms and grain farms. Inquiry has shown that tenants remain longer where the lease is on a one-year basis, but renewable if both parties are satisfied.

FINANCIAL ANALYSES OF THE FARM BUSINESS.

Analyses of the farm business as developed in various regions have been made and have been especially helpful in furnishing information on the amount of capital required for each type of farming and for the various-sized farms. Especially valuable information is available on the returns which may be expected from farming in each district and under different systems of management. The proportion of capital invested in land and real estate, in equipment and work stock, and in funds for operating the business has been determined for each kind and type of farming.

Investigations on this subject are being extended from time to time in new areas where conditions are changing and where additional data are needed, as well as in the same areas over 5- and 10-

year periods. These continuing studies are especially valuable in revealing the changes that take place in farm organization over a period of years.

FARM BOOKKEEPING AND ACCOUNTING.

The increased efficiency demanded of farmers under the stress of war conditions, necessitating the elimination of waste of effort on nonproductive enterprises, has emphasized the need for more careful farm bookkeeping and accounting. Fortunately, through studies in this office, systems and forms for farm bookkeeping and accounting have been developed and made available which are proving very satisfactory for the farmer's use.

Attention is now being directed to a study of the more intricate problems of bookkeeping, especially on large estates and farming corporations, and to the application of the methods of farm bookkeeping and accounting to the needs of farmers with reference to the determining of the income tax.

HISTORY AND DISTRIBUTION OF FARM ENTERPRISES.

Work on the history and distribution of farm enterprises has been primarily in connection with the preparation of the various chapters of the "Atlas of American Agriculture." However, within the past year only such work has been prepared as has been of immediate use in connection with the war program. The "Geography of the World's Agriculture," recently published, has been of great value in furnishing information with respect to agricultural production in foreign countries. Since the publication of this atlas additional data have been gathered on the resources and agricultural possibilities of various foreign powers, with a view of determining the relationship that exists between the production in this country and abroad. Supplementing this work a Yearbook article entitled "The World's Supply of Wheat" has been published.

Much of the routine work that has been done in cooperation with other bureaus of the department and with other departments has been discontinued for the time being, in favor of activities having a more direct bearing on the war emergency. Of the latter, the preparation of maps and graphs showing the average dates of planting and harvesting important crops in various States has been of special value to those concerned with the problem of the supply of labor. Other activities have been along the line of supplying information on the number of laborers employed and the season of the year in which they are most needed, as determined from the labor requirements of various crop and live-stock enterprises. All of this work has contributed information useful in the prosecution of the war, and practically all the publications issued during the year have been made specifically for the purpose of meeting the unusual needs of the hour.

FARM PRACTICE IN RELATION TO MAINTENANCE OF CROP YIELDS.

Investigations that have been conducted by the Office of Farm Management for a number of years indicate that very important in-

formation can be developed from a close study of the various farm practices in relation to the use of barnyard manure and other means of maintaining crop yields. These studies indicate that there is a very direct relationship between certain farm practices and the maintenance of maximum yields through a wise use of available manures and fertilizers. These practices have been studied in detail especially in the Eastern States, and publications describing them have been issued. Further investigations along this line are in progress.

PROBLEMS OF MANAGEMENT IN SPECIFIC AREAS.

The abnormal changes occasioned by prevailing war conditions have developed special problems in the management of farms in various parts of the country. The solution of these problems is a matter of readjustment of the farming system so that it may be operated with less labor and a smaller supply of materials in the way of equipment and fertilizers, and at the same time maintain or increase production of the staple crops and classes of live stock. In short, they mean putting the farm on a war basis. These readjustments in the farming operations vary widely according to the region concerned.

NORTHERN ATLANTIC STATES.

In the Northern Atlantic States the primary problem has been one of finding an adequate supply of grains and forage on dairy and poultry farms. Prior to the war, it was a custom for dairymen to purchase large quantities of concentrated feeds and to grow all the roughage needed for their live stock. With the abnormal price of concentrated grains in the past year and with the great scarcity of many of the products, it became necessary to make an almost complete readjustment of the farming system on many of these farms so as to provide a larger supply of home-grown grains. Such a change called for new equipment and new rotations, and made new requirements in the way of labor and materials. The results of farm-management investigations have been extremely helpful in throwing light on this problem, furnishing, as they have, data on the requirements of the various crops and the best ways of fitting them into the farming systems.

Correlated with this problem is that of providing more of the food products used by the farm family. Very marked results have been effected in this direction through greater production of home supplies, in many cases so abundantly that a surplus has been available for people living in neighboring towns and villages.

MIDDLE ATLANTIC STATES.

As already pointed out, one of the most direct means of maintaining or increasing production under war-time conditions is by increasing crop yields. This can often be done with a minimum expenditure of labor and funds and with very marked results. In the Middle Atlantic States large areas of land are found where crop yields have declined to a low level. Farm-practice investigations in these areas indicate that when certain systems of farming are followed, very substantial increases in yields of staple crops are realized. Moreover, these increased yields are obtained with com-

paratively little expenditure for fertilizers or for increased labor. This problem, as well as methods which will result in the saving of labor on various crops and enterprises, is being studied throughout the entire area.

COTTON BELT.

A number of factors, even aside from the stress of the war situation, have contributed to making the problems of management in the cotton States extremely difficult. The advance of the boll weevil toward the Atlantic coast, labor difficulties, the increasing need for production of home supplies, the increased demand for feed crops, and the decreasing yield occasioned by lack of available fertilizers, have all contributed to making more difficult the problems of farming in many of the cotton-growing areas. The work of the Office of Farm Management in this region has been directed particularly to the development of systems of live-stock farming in areas where live-stock raising can be made a profitable enterprise, where the production of feed crops is feasible, and in general to the development of farming systems that will be safe and sufficiently diversified to insure a maximum use of labor on profitable enterprises. Particular attention has been directed to the use of cover crops and green manure. Especially valuable results have been obtained through a study of rotations in the Piedmont section, where farmers have used clover extensively and successfully.

CORN-BELT STATES.

Investigations of certain problems of management of farms in the corn belt have been continued. These investigations pertain particularly to the question of saving labor and to fitting certain crops into the farming system. Very valuable data have been obtained as to harvesting crops by live stock, a practice that is rapidly gaining in favor in all parts of the Central States. A study has been made to determine the place that alfalfa should occupy in corn-belt agriculture, and the experiences of a large number of corn-belt farmers who have grown alfalfa have been drawn upon in this investigation. The most difficult feature of the problem of growing alfalfa in the corn belt is the question of harvesting the first crop of alfalfa, which must be cut when corn urgently demands cultivation. The solution seems to lie partly in improved methods of harvesting the alfalfa hay.

OHIO VALLEY AND OZARK REGION.

The large belt of farming area situated between the corn belt on the north and the cotton belt on the south and extending from the Appalachians to the western borders of the Ozarks is one to which very little attention has hitherto been given in the way of developing profitable systems of farming or the maintenance and upbuilding of soil fertility. Only recently has the Office of Farm Management given specific attention to the problems of this region, but already investigations indicate that improved systems of farming can be developed which will effect a marked gain in the profits to be derived from agriculture in this region, mainly through improved practices which will increase crop yields.

PLAINS STATES.

Because of the extreme variation in rainfall in many parts of the area, one of the primary problems in the Plains States is the establishment of a safe type of farming. The district is now one of small-grain production and of extensive farming. Certain systems of farming embodying live stock have been found to give their operators very good success in many parts of this region. The experiences of these farmers are being studied with a view of developing types of agriculture which will insure a more stable production and lessen the hazards so common to straight grain farming in this region to-day.

PACIFIC NORTHWEST.

The activities of the Office of Farm Management in the Northwestern States have been confined almost entirely to the study of farm practices which have been found to increase the yields of wheat in the dry-farming areas of this region. Through a careful analysis of the practices and experience of the more successful wheat growers in eastern Washington and western Idaho, our investigators have been able to develop certain practices which, when followed, insure greatly increased yields on most farms.

PACIFIC AND MOUNTAIN STATES.

Owing to the wide variation in conditions, the problems of management in the operation of farms in this region are extremely diverse. Attention has been directed to the development of successful live-stock farms on irrigated areas, and to the development of types of farming which will include crops that are particularly well adapted to these farms.

FARM-MANAGEMENT DEMONSTRATION WORK IN THE SOUTHERN STATES.

In January, 1917, the Office of Farm Management entered into a cooperative agreement with the extension forces in southern States for carrying on farm-management demonstration work through the various existing State agencies. The object of this cooperative work is to assist the State extension divisions and county agents in solving the important problems of management that have a direct bearing upon the profits and losses on farms in the cotton-growing region. Under this arrangement farm-management specialists have been placed in a number of the southern States to work in cooperation with the extension forces. A number of other States are ready to take up this work as soon as finances and workers are available.

During the past year particular attention has been directed to the problems which have a bearing upon the war program, such as that of providing an adequate supply of food products for home needs and for nonproducers in adjacent towns and villages, and that of maintaining or increasing crop yields through more effective use of cover crops and green manures, in view of the shortage of commercial fertilizers.

Effort has been made to introduce labor-saving methods and practices wherever possible.

INDEX.

	Page.
Abortion, infectious, of cattle, investigations and control.....	113-114, 129-130
Accounting—	
farm, improvement, result of extension work.....	363
systems in farm marketing, Markets Bureau.....	461-462
Accounts Division, report of Chief, 1918.....	277-279
Aerological investigations, Weather Bureau, 1918.....	62-63
Agricultural—	
Advisory Committee, National, work and personnel.....	11-12
agencies, work in war emergency.....	3-4, 12-13
Agriculture Department—	
appropriations and expenditures, 1918, and 1839-1918.....	277-279
cooperative work in war emergency, summary.....	13-15, 52-53
International Institute, communications.....	313
Aircraft, Production Bureau—	
cooperation of Forest Service.....	180, 194-196
cooperative work of Chemistry Bureau.....	213
Airplane, construction, lamination, drying problems, etc.....	195-196
Alaska Experiment Stations, work, 1918.....	345-346
Alfalfa—	
weevil, progress and control.....	238
yellows, studies.....	155
Alkaloids, identification by optical methods.....	223
Alkanet, substitute, examination.....	221
ALSBERG, CARL L., report as Chemist, 1918.....	201-224
Ammonia, synthetic, production by Haber process.....	230-231
Analysis, methods, studies and papers prepared.....	222-223
Animal—	
breeding, work of Department, 1918.....	72, 78, 81-83
by-products—	
importations.....	106
marketing, investigations.....	465-466
diseases—	
control, work of Department, 1918.....	16-18
eradication, work, 1918.....	73-75, 107-112
investigations and control work, 1918.....	112-120, 121, 122-126, 127-131
Husbandry Division, work, report, 1918.....	77-87
Industry Bureau—	
meat inspection service.....	14
personnel changes, etc.....	126
report of Chief, 1918.....	71-133
quarantine laws, administration, fines, etc.....	417
Animals—	
domestic, insects injurious, investigations.....	243, 249
export, inspection.....	106
imported, inspection and quarantine.....	105
inbreeding, studies.....	86
predatory—	
control work, 1918.....	18
control work, Biological Survey.....	257-262
rabies, infection and spread, investigations, 1918.....	258-259
wild, autopsies, 1918.....	117
Ant, Argentine, control work.....	246, 249
Anthrax, control work.....	108
Aphis, control on potatoes, spinach, peas, etc.....	241, 242, 249
Appalachian forests, purchase areas, location, and acreage.....	169-172

	Page.
Apple diseases, control methods.....	154
Apples, insects injurious, control work.....	233-234
Appropriations, Agriculture Department, 1839-1918.....	278-279
Arizona, prairie dogs, control methods, results.....	260
Army, assistance of Weather Bureau.....	59-63
ARNOLD, JOS. A., report as Chief of Division of Publications.....	281-304
Arsenates, use in insecticides, investigations.....	427-428
Arsenic, spray, plant injury, studies.....	222
Arthritis, disease of hogs, investigations.....	115
<i>Asclepias verticillata</i> , poisonous to live stock.....	118
Ash, wood, protection from powder-post beetles.....	244
Asparagus, rust-resistant, breeding and distribution.....	141, 157
<i>Astragalus diphysus</i> , a loco weed, poisonous properties.....	118
Atlantic States, farm management problems, investigations.....	497
Automobiles, statistics, registration, and fees.....	382
Autopsies, wild animals, 1918.....	117
<i>Bacillus botulinus</i> , cause of forage poisoning of animals.....	116
Bacteriology, studies, Dairy Research Laboratories.....	94-95
Banana—	
plant, quarantine for root borer.....	444
pulp, wheat flour substitute, use in Hawaii.....	347
root borer, quarantine.....	444
Barberry plants, relation to black stem rust of wheat.....	153
BARNETT, CLARIBEL R., report as Librarian, 1918.....	319-334
Beans—	
insects, injurious, control.....	242
poisonous, treatment for removal of poison.....	217
velvet, feeding experiments.....	81, 82, 132
Beavers, mountain, injurious to crops, investigations.....	262
Bee culture, investigations.....	249, 250-253
Beef—	
cattle—	
investigations, breeding and extension in the South.....	72, 80-82
production on farms, studies.....	494
industry on reclamation projects.....	150
production—	
increase since 1914.....	6, 8
work in the South.....	80-81, 132
Beetle, Japanese, introduction, habits, and control.....	237
Beetles, lumber destruction, prevention measures.....	244-245
Beets, sugar—	
growing, and condition of beet-sugar industry.....	147-148
nematode, studies.....	156
production, farm practice studies.....	493
Bibliographies, work of Library, 1918.....	323-324
Binder twine, fibers, work of 1918.....	161
Binders, road, research by Roads Bureau.....	385
Binding—	
expenditures, 1918, and printing.....	282-286
work of Library, 1918.....	7
Biological—	
Survey, report of Chief, 1918.....	257-275
surveys, field work.....	265-266
Bird—	
counts, work of observers, 1918.....	265
reservations, location and work, 1918.....	270-271
reserves, trespass law, violations, etc.....	394, 419
Birds—	
distribution and migration, reports.....	265
importations, 1918.....	271-273
migratory, Federal law enforcement, details.....	273-275
Blackbirds, damages to rice.....	264
Blackleg vaccine distribution.....	116
Blastophaga, introduction and use in Southern States.....	163
Blight, chestnut, resistant species, possibilities.....	155
Blotch, apple, control.....	154
Blueberry, propagation.....	163
Boll weevil, cotton, control by dust insecticides.....	243

	Page.
Bollworm, pink—	
distribution, and control work, quarantine, etc.....	432-438
of cotton, quarantine work, 1918.....	26-27
Bonds, issues, cooperation of Roads Bureau with Capital Issues Committee.....	374, 388, 389
Bookkeeping, farm, development of system and form.....	6
Borax, stable manure, fertilizing value.....	218
Bordeaux mixtures, investigations.....	428, 429
Borer—	
banana root, quarantine.....	444
corn, European, introduction, habits, and control.....	237-238, 248
Borers, fruit-tree, investigations.....	234, 236
Boys' clubs, organization, membership, and work.....	337, 356-357, 364-366
BRAND, CHARLES J., report of Chief of Bureau of Markets, 1918.....	451-489
Breads, digestibility and food value, studies.....	369, 370
Breeding—	
animal, work of Department, 1918.....	72, 78, 81-83
grounds of migratory wild fowls, investigations.....	266
plant, experiments, 1918.....	136-141
Bridges, designs, preparation for State highways, by Roads Bureau.....	381
Brown-tail moth, work, 1918.....	253-256
Bud selection, for fruit improvement.....	140
Buildings, farm, plans and specifications, work of Roads Bureau.....	390-391
Bull associations, number and work.....	88
Burlap, importations, 1918.....	439-440
Burros, wild, injury to ranges in National Forests.....	185
Butter, renovated, factory inspection, results.....	92
California—	
Berkeley, headquarters of Farm-irrigation Division.....	387
forest insects, survey and control, recommendations.....	244
Camphor, growing in Florida, progress.....	163-164
Canker, citrus—	
eradication, progress.....	155
eradication work, 1918.....	29-30
Canna, edible, potato substitute, growing, Hawaii.....	347
Canned goods, slack filling, control.....	205-206
Cantala, growing and cleaning for use as fiber.....	161
Capital Issues Committee, aid of Roads Bureau in bond issues.....	40, 374, 388, 399
Caprification, fig, work in Southern States.....	163
Cars—	
disinfection, in Texas-border quarantine.....	28
refrigerator, investigations and improvement by Markets Bureau.....	463
Castor beans, growing, and injury by wilt disease and cutworms.....	143-145, 158
Cataloguing, work of Library, 1918.....	323
Cattle—	
drought-stricken, saving by transfer from Texas to other States.....	77
eye disease, description and control.....	115
feeding experiments, work, 1918.....	80-81, 82, 83, 132
grazing in National Forests, numbers, conditions, etc.....	184, 185, 187
imported, tuberculin tests, results.....	105
keratitis, control.....	131
lice, control.....	123
numbers, increase since 1914.....	6, 8
scabies, eradication.....	107
transportation from drought-stricken regions of Texas.....	354-355
tuberculin testing, cooperative work in States, results.....	110
Cereals—	
acreage and production, 1918, comparison with previous years.....	5, 7
insects injurious, investigations.....	237-240, 248
smuts, study.....	153
studies.....	220
Cheese—	
cottage, production for food conservation.....	75, 89-90
factories, extension work.....	92
manufacture and ripening, laboratory work.....	96
soft, infection with tubercle bacilli, prevention.....	130-131
Chemical investigations, Soils Bureau, 1918, liming of soils, etc.....	230
Chemicals, determinations in compounds, methods.....	222-223
Chemist, report, 1918.....	201-224

Chemistry—	
Bureau—	Page.
collaboration with other Departments, etc.....	223-224
cooperation with State and municipal officials.....	207
cooperation with War Department, etc.....	14
research work, 1918.....	201, 217-223
research papers, in course of preparation.....	222
Chestnut blight, resistant species, possibilities.....	155
Chickens, gapeworm, investigations.....	125
Cholera, hog—	
control, and investigations.....	73-74, 128-130, 137-138, 139
control work, 1918.....	16-17
spread methods.....	119-120
virus and serum preparation, control work.....	129
Cider, fermentation, studies.....	219
Citrus—	
canker—	
eradication, progress.....	155
eradication work, 1918.....	29-30
insect pests, control.....	245-247, 249
City—	
market news service.....	479-480
marketing and distribution of foodstuffs, studies.....	458-459
Climatology, work of Weather Bureau, 1918.....	63-64
Clubs, boys' and girls'—	
enrollment and work, 1918.....	78, 80, 85
organization, membership, and work.....	341, 355-357, 364-366
Codling moth, investigations and control.....	233, 235
Cold storage, reports.....	481
Color investigations, Chemistry Bureau, and patents secured.....	214-215
Colors, food, work of Chemistry Bureau, 1918.....	206
Conservation—	
food—	
necessity of continuation.....	9
publications, 1918.....	291-293
foodstuffs, work of chemistry Bureau.....	208-209
Container, standard, enforcement of law, Markets Bureau.....	486-487
Containers, waterproof, etc., studies, Chemistry Bureau.....	216
Cooperation—	
official agencies, emergency work.....	10-12
Soils Bureau, with States and with other offices.....	225, 228-229
Cooperative—	
extension service, work and importance.....	12-13, 53
loan associations, benefits to farmers.....	44-45
purchasing and marketing organizations, investigations.....	456
Copra, crushing industry, study of value of products.....	218
Corn—	
acreage and production, 1918, comparison with previous years.....	5, 7
belt, farm management problems, investigation.....	498
borer, European, introduction, habits, and control.....	237-238, 248
breeding work, 1918.....	139-140
diseases, study.....	153
growing, seed-germination studies.....	146-147
sweet, resistant to the corn earworm.....	139
Cornea, ulceration, cattle, control.....	131
<i>Cosmopolites sordidus</i> , forage poison.....	116
Cotton—	
Acala, origin and description.....	138
acreage and production, 1914-1918.....	7
belt, farm management problems, investigations.....	498
breeding work, 1918.....	136-139
districts, live stock, experiments and demonstrations.....	131-133
fiber testing, effect of mercerizing, etc.....	470
Futures Act—	
administration, Markets Bureau, 1918.....	482-484
assistance of Solicitor.....	419
glands, oils, studies.....	217
growing, community work for protection of seed supply.....	146

Cotton—Continued.	Page.
handling and marketing, investigations.....	466-468
importations, regulations and quarantine restrictions.....	438-440
Lone Star, origination and value.....	137
low-grade, distribution, work of Department.....	25-26
Meade, long-staple variety to replace Sea Island, description.....	137
pink bollworm, quarantine work, 1918.....	26-27
standards—	
investigations and demonstration.....	469-470
preparation and distribution.....	483-484
warehousing, investigations.....	469
waste importations, 1918.....	439-440
wilt control by use of wilt resistant varieties.....	157
Cottonseed—	
marketing, and its products, investigations.....	468
meal, feeding to work stock, experiments.....	83-84
County agents, work in South, North, and West.....	352-355, 357, 359, 360
Cowpeas, new hybrids.....	140
Cows, number, increase since 1914.....	6, 8
Cow-testing associations, organization, number, and work.....	87-88
Cranberries, insects injurious, investigations.....	235-236
Creamery—	
by-products, casein supply.....	96
Grove City, work of Dairy Division.....	91-92
Credits, personal, unions, need among farmers.....	43-45
Credits, rural, investigations.....	472
Cricket, Coulee, control.....	239, 248
Crop—	
Estimates Bureau—	
library, work of year.....	313
personnel and administrative work.....	305-307
report of Chief, 1918.....	305-318
work, organization and system.....	30-32
indicator, value of natural vegetation.....	159
reporters—	
voluntary, number and work.....	31
voluntary, number and work, 1917, 1918.....	309
reporting, field service and cooperative work.....	307-309
reports—	
1918, and monthly, and special reports.....	309-310, 314-317
collection, method.....	31
special, work of Crop Estimates Bureau.....	316-317
Crops—	
acreage—	
and yields, 1918, comparisons with previous years.....	5, 7
increase in South.....	354
economics, various sections, investigations.....	493-494
protection, work of Weather Bureau, 1918.....	69-70
records, work of Crop Estimates Bureau.....	312-313
values with live stock, 1914, 1917, 1918.....	8
Currant, spread of white pine blister rust.....	154-155
Cutworms—	
castor bean destruction in Florida.....	145
control experiments.....	239
Dairy—	
cattle, breeding experiments.....	97
Division, experimental work at Beltsville Farm.....	97-98
extension work in South and West.....	87-90
feeding, experiments.....	97-98
industry, improvement, work of Department.....	19-20
investigations, 1918.....	75, 87-88, 91-92
manufactures, investigations.....	91-92
products—	
market news service.....	22, 477
marketing investigations.....	464
utilization, emergency work.....	75
research, laboratory work.....	94-97

	Page.
Dairying—	
community development.....	88-89
demonstration work on reclamation projects.....	149
Date palm, physiological requirements, climate and soil.....	160
<i>Daubentonia longifolia</i> , toxic properties.....	118
Daylight saving law, relation to work of Weather Bureau.....	58
Dehydration. <i>See</i> Drying.	
Demonstration farm—	
county agents, South, North, and West.....	354, 360, 366
Entomology Bureau.....	247-249
Hawaii, results.....	348
reclamation project.....	148-150
Southern States.....	499
Derris, use as insecticide, investigations.....	235
Dietary survey, cooperative work of Home Economics.....	369-371
Dips, animal, examination.....	120-121
Diseases—	
animal, investigations and control work, 1918.....	115-120, 121, 122-126, 127-131
bees, investigations.....	253
plant, investigations.....	153-158
Disinfection—	
cars from Mexico in quarantine service.....	28
hides, methods.....	121
Document Section, Publications Division, work, 1918.....	301-304
Document Superintendent, sales of Department publications.....	294-295
Dourine, eradication, progress.....	107-108, 113
Drainage—	
investigations, 1918.....	388-390
systems, results of county agents' extension work.....	363
Drought—	
1918, effects in Southern States.....	354-355
resistance of crops.....	159
Drugs—	
adulteration and substitution, control work.....	206, 208, 221
imports, substitutes and adulteration.....	208
Dry farming, Great Plains, cooperative work, 1918.....	145
Drying—	
fruits and vegetables, work of Chemistry Bureau.....	209, 213
leaf tobacco, patent process for public use.....	156
Ducks, wild, damages to rice.....	264
<i>Duqualdia hoopesii</i> , cause of spewing sickness of sheep.....	118
Dust—	
explosions, mills and elevators, control work.....	211, 214
insecticides, experiments.....	234, 236, 243
preventives, research by Roads Bureau.....	385
Dyes, certification, and preparation, work of Chemistry Bureau.....	206, 213, 215
Earworm, resistance, corn breeding.....	139-140
Economics, home, work, 1918.....	369-371
Editorial work—	
Publications Division, 1918.....	295-296
States Relations Service.....	338-339
Education, agricultural, in schools, investigations, States Relations Service..	339-341
Eggs—	
frozen, judging methods.....	220
handling, work of Chemistry Bureau.....	210
preservation, increase.....	79
production, increase since 1914.....	6, 8
substitutes, examination.....	205
Elevators, dust explosions and fires, control work.....	211
Elk, conditions on game reservations, numbers, and feeding methods.....	267-268
Emergency—	
food production, activities of Department.....	52-53
traffic and storage, assistance of Markets Bureau.....	480
war—	
entomological intelligence service.....	249-250
food use, instruction courses.....	371

	Page.
Engineering, rural, work of Roads Bureau, 1918.....	390-392
Entomologist, report, 1918.....	233-256
ESTABROOK, LEON M., report as Chief of Bureau of Crop Estimates.....	305-318
Estimates, monthly, crops and live stock conditions.....	314-315
<i>Euscepes batatae</i> , sweet-potato pest, cause of quarantine.....	444
Exhibits—	
Entomology Bureau.....	249
Government, Joint Committee, organization and work.....	38
Office, work, exhibitions and demonstrations, 1918.....	37-38
Expenditures—	
Agriculture Department, 1839-1918.....	278-279
forest protection on watersheds, by States.....	193
printing and binding.....	282-286
Experiment Farm, Beltsville, Md., animal industry work.....	81, 82, 84, 86, 97-98
Experiment Station, Bethesda, Md., work on animal diseases, 1918.....	129-131
Experiment Station Record, work, 1918.....	344
Experiment Stations—	
agricultural, relations with Department.....	343-344
Office, work, 1918.....	342-351
Explosions, dust, mills and elevators, control work.....	211, 214
Exports, meat and meat products, inspection and certification.....	101
Extension Service, importance and work.....	12-13, 53
Extension work—	
cooperation of Department specialists.....	357, 367-369
Entomology Bureau.....	247-249
North and West, report, 1918.....	335, 358, 359
South, report, 1918.....	335, 351-358
Eye disease of cattle, description and control.....	115
Farm—	
buildings, plans and specifications, work of Roads Bureau.....	390-391
business, financial analysis studies.....	495
enterprises, history and distribution.....	496
equipment, investigations.....	494-495
irrigation, investigations, 1918.....	387-388
labor supply—	
cooperative work.....	35
to farmers, work of Office of Farm Management.....	491-492
Loan Act, practical application.....	43-45, 48
management—	
demonstration work.....	366, 369
Office, report of Chief, 1918.....	491-499
practice, periodical, work of Entomology Bureau.....	245
problems, mechanical, work of Roads Bureau.....	391
products, marketing and distribution, investigations.....	456-468
records, bookkeeping and accounting problems.....	496
women, demonstration and extension work.....	355, 366-367
Farmers—	
American, achievements during war, tribute to.....	317-318
Bulletins, issue, 1918, names, numbers, reprints, and output.....	282, 284, 287, 288-290
Institutes, investigations.....	341-342
seed-grain loans, conditions, number, and amount.....	32-35
Farms, management problems in specific areas or sections.....	497-499
Feed—	
crops, supplementary, growing on reclamation projects.....	148
law, necessity.....	52
market news service, work, 1918.....	22
Feeding—	
live stock, experimental work.....	81, 82, 83, 97-98, 132
poultry, experimental work.....	72, 79, 84
Feeds, market news service.....	477-478
Fertilizers—	
law, necessity.....	51
resources, investigations.....	230-232
studies and field tests.....	160

	Page.
Fertilizers—Continued.	
substitutes, examination.....	160
surveys, work of Markets Bureau.....	455-456
use, increase, under extension work.....	363
Fibers, binder-twine, work, 1918.....	161
Field crops, Southern, insect investigations.....	243
Fig, caprification, work in Southern States.....	163
Films, production and distribution, work of Illustrations Section.....	299-300
Fires—	
forest—	
control, appropriation need.....	41-42
prevention in National Forests, numbers and losses.....	166, 174-178
mill, elevator, and thrasher, control work.....	211
National Forests, 1917, extent and causes.....	177
Fish—	
preservation methods, work of Chemistry Bureau.....	208-209
shipment, supervision by Chemistry Bureau.....	210-211
spoilage studies.....	220
Flax—	
straw, utilization for paper making.....	151
winter, experiments.....	163
Fly, melon, quarantine of Hawaiian fruits.....	247
Flood service, Weather Bureau work, 1918.....	65-66
Florida—	
bird reservations, conditions, 1918.....	270
camphor-growing progress.....	163-164
Food—	
Administration work, cooperation of Chemistry Bureau.....	211-212
adulteration, suppression by Chemistry Bureau.....	203, 204, 205-206, 220
and Drugs Act—	
administration and cases of interest.....	407-415
enforcement by Chemistry Bureau.....	202-208
conservation and production, 1918.....	291-293
Control Act, assistance of Solicitor.....	393, 420
emergency production, activities of Department.....	52-53
inspection for Army and Navy supplies.....	75-76, 92, 93, 103
poisoning, studies.....	220
Production—	
Act, administration, assistance of Solicitor.....	393, 421
and conservation, work of Extension Office.....	336, 348, 353, 354, 356, 360, 362, 363, 364, 366
products—	
inspection, organization and work, 1918.....	23-24
inspection service.....	480-481
spoilage and fermentation, studies, Chemistry Bureau.....	220-221
substitutes, examination, Chemistry Bureau.....	205
supply, investigations by Markets Bureau.....	453-455
surveys, work of Markets Bureau.....	455
transportation and storage, investigations.....	459, 460
Foods—	
exhibit, Hawaii, at Territorial fair.....	347
imports, adulteration.....	206
utilization, studies.....	370
Foot-and-mouth disease, inspection.....	107
Forage—	
insects, injurious, investigations.....	237-240
poisoning, cause, study.....	116
Forecasts, Weather Bureau, 1918.....	59-61, 69
Forest—	
fires, control, appropriation need.....	41-42
management, work of Forest Service, timber, grazing, etc.....	179-192
National—	
areas, changes, management, uses, receipts, etc.....	166-192
land classification and elimination.....	170-172
laws, administration, decisions, etc.....	398-406
protection from fires, insects, and rodents.....	166, 174-179
purchase areas in Appalachians, location and acreage.....	169, 172
roads, surveys and construction.....	380

Forest—Continued.	Page.
products, utilization in war work, laboratory studies, etc.....	193-200
resources, insects injurious to, investigations.....	244-245
Forest Service—	
cooperation with War and Navy Departments.....	14
emergency work on account of war.....	165-166, 193-200
law, work, 1918.....	395-396, 398-506
personnel, changes and depletion by war conditions.....	167-168
Forester, report, 1918.....	165-200
Fraud orders, fake medicines in mails, cooperation of Chemistry Bureau and Post Office Department.....	223
Fraudulent medicines, marketing by mail, work against.....	223
Frost, warnings, work of Weather Bureau, 1918.....	59-60, 69
Fruit—	
crop estimates, work, 1918.....	313-314
fly, Mediterranean, quarantine, of Hawaiian fruits.....	247
improvement through bud selection.....	140
storage investigations.....	151-152
trees, stocks, investigations.....	152
Fruits—	
deciduous, insects injurious, investigations.....	236-238, 249
drying, work of Chemistry Bureau.....	209, 213
handling in transit and storage, for prevention of decay.....	463-464
Hawaiian, quarantine for Mediterranean fruit fly and melon fly.....	247
insects injurious.....	236-238, 245-247
market news service.....	473-475
production, 1914-1918.....	7
small, rots and spoilage, prevention.....	153-154
Fuel emergency, results in increased use of wood as fuel.....	199
Fungicide Board. <i>See</i> Insecticide Board.	
Fungicides—	
inspection and special investigations.....	425-430
samples, collection in interstate and foreign shipments.....	425-426
Fur bearers, investigations, 1918.....	263
Game—	
interstate commerce, regulations, violations, etc.....	271-273
laws, information, work of Biological Survey.....	273
National Parks, investigation.....	266
protection—	
on National Forests.....	188-189
work, 1918.....	266-271
Gelatin, adulteration, dangers.....	205
Georgia, fig caprification.....	163
Gipsy moth, work in 1918.....	253-256
Girls' clubs, organization, membership, and work.....	337, 355-356, 364-366
Glanders, investigations.....	113
Globulins, various foods, studies.....	218
Glue, waterproof, development and use in airplane construction.....	196
Gophers, pocket, control work.....	261
Grades, market, investigations.....	457-458
Grain—	
handling in bulk, investigations.....	471
inspection, supervision.....	485-486
market news service.....	477-478
market work, 1918.....	22
standardization, investigations.....	470-472
Standards Act—	
administration, Markets Bureau, 1918.....	484-486
assistance of Solicitor.....	394, 419-420
enforcement, 1918.....	24-25
Grains—	
insects injurious.....	240
storage and handling, investigations.....	471
Grape, berry moth investigations and natural control.....	234, 236
Grapes, insects injurious, control work.....	234
Grass, Rhode Island bent, seed industry revival.....	142
Grasshoppers, control, cooperative work.....	238, 248

	Page.
GRAVES, HENRY S., report as Forester.....	165-200
Grazing permits, National Forests, 1918, and management of live stock..	166, 183-187
Great Plains, dry farming, cooperative work, 1918.....	145
Greenhouse, insects, investigations.....	247
Greensand, value as source of potash, studies.....	158-159
Guam Experiment Station, work, 1918.....	349-350
<i>Gutierrezia diversifolia</i> , sheep poisoning, investigations.....	118
Hair, animal, supply, reports.....	476
Hawaii Experiment Station, work, 1918.....	346-348
Hay, market news service, work, 1918.....	22, 477-478
HAYWOOD, J. K., report as Chairman, Insecticide and Fungicide Board....	425-430
Health—	
insects affecting, investigations.....	243-244
rural, safeguarding, importance and needs.....	53-54
Hemp, varieties, and progress of industry.....	161-162
Herds, cattle, tuberculosis-free accredited.....	111
Hessian fly, control, progress.....	239, 248
Hides, disinfection, methods.....	121
Highway maps, preparation by Roads Bureau.....	374, 381
Highways—	
Council, United States, composition and work.....	40-41
construction, work of Roads Bureau.....	39-41, 49-50
State expenditures, 1918, statistics collection.....	382
surveys, models, and exhibits, 1918.....	381-383
United States Council, cooperation with Roads Bureau.....	374
Hog—	
lice, control.....	123-124
mange, investigations and control.....	123
roundworms, investigations and control.....	125
Hogs—	
breeding and feeding, work, 1918.....	72, 77-78, 82, 132
increase on farms.....	128
joints, inflammation, investigations.....	115
losses, decrease under hog-cholera control.....	128
numbers, increase since 1914.....	6, 8
raising on reclamation projects, demonstration work.....	149, 150
Home—	
demonstration work with farm women and girls.....	355-356, 366-367
economics, work, 1918.....	369-371
insect pests control, studies, and bulletin concerning.....	429-430
Honey, production increase.....	250
Horses—	
American carriage, breeding, work of Department.....	83
Army, breeding, work of Department.....	83
breeding, work of Department.....	83
grazing in National Forests, numbers.....	187
intestinal nematodes, investigations.....	125
number, increase since 1914.....	6, 8
wild, injury to ranges in National Forests.....	185
Horticultural Board, Federal, report of Chairman.....	431-449
HOUSTON, D. F., report as Secretary of Agriculture, 1918.....	3-54
HOWARD, L. O., report as Entomologist.....	233-256
Hydrocyanic acid, liquid substitution for gas, experiments.....	246
Idaho—	
ground squirrels, eradication work.....	261
Thunder Mountain Country, forestry conditions memorial, citation.....	174
Illustrations, work of Publications Division, 1918.....	297-301
Importations—	
birds and mammals, 1918.....	271-273
nursery stock—	
origin and destination.....	441-443
restrictions.....	29
Imports, foods and drugs, substitutions and adulterations.....	207
Inbreeding, animals, studies.....	86
Indexing, work of Publications Division, 1918.....	296-297

	Page.
Influenza, horses and mules, control work	108
Information Service, work, 1918	35-37
Insect powders, investigations	427
Insecticide—	
Act, administration by Department, fines, etc	418
Board, Report, 1918	425-430
examination by Biochemic Division	123
inspection and special investigations	425-430
orchard and spraying machinery, investigations	234, 235, 236, 237, 249
samples, collection in interstate and foreign shipments	425-426
tests and studies	222
Insects—	
cereal and forage, investigations	237-240, 248
deciduous fruits, investigations	233-237, 249
field-crop, investigations	243
fruit, tropical and subtropical, investigations	247-249
health affecting, investigations	243-244
household, control studies, and bulletin concerning	429-430
injurious to domestic animals, investigations	243-249
stored products	240, 248
tree, investigations	244-245
vegetable and truck crops, investigations	240-242, 248
Inspection—	
food products, organization and work, 1918	23-24
grain, supervision	485-486
live stock, ante-mortem and post-mortem, condemnations, etc	98-100
market, work, 1917	158
meat—	
violations of law, fines, etc	415-416
work in 1918	88-96
nursery-stock importations	443
plants in mail shipments, interstate	445
stored products for insect control	240, 248
Instruments, construction, tests and repairs, work of Weather Bureau, 1918	70
Insular stations, work, 1918	345-351
Insurance, rural, investigations	472
Interstate commerce, live stock, sanitary work	111-112
Irrigation, farm, investigations, 1918	387-388
Joint disease, hogs, investigation	115
Jointworm, injury to wheat, and control work	239
Karaya gum, substitute for tragacanth	221
KELLERMAN, K. F., report as acting Chief, Bureau of Plant Industry	135-164
Kelp, utilization, studies and experimental work	231-232
Keratitis, cattle, control	131
Kitchen, demonstration, use in extension work	365, 371
Kites, use in aerological investigations	62
Labor—	
farm—	
securing, aid of county agents	360
supply, cooperative work	35
supply to farmers, work of Farm Management Office	491-492
saving, machine work, Document Section	303-304
Laboratories, meat-inspection, work, 1918	103-104
Laboratory, forest, investigations of forest materials	194-197
Lacey Act, administration by Department, fines, etc	418-419
Ladybird, Australian, use in control of fluted scale	246
Land—	
classification, work of Soils Bureau	226
forestry, claims and decisions	398-400
settlement, tenancy and ownership, discussion	49
Lantern slides, educational, preparation, States Relations Service	340
Law—	
bird, administration	273-275
Food and Drug	202-208, 407-415
work, Solicitor's Office, summary	393-398

	Page.
Laws—	
feed and fertilizer, necessity.....	52
forestry, decisions on cases, 1918.....	399, 402-404
preparation and examination by Solicitor.....	393-394, 396, 405
violations, prosecution by Solicitor's Office, 1918.....	397, 401, 417-420
Leaf rollers, control on small fruits.....	242
Leaf-cut, cotton seedlings, cause.....	159-160
Leafhopper, beet, control.....	242
Leaflets, food, preparation, subjects and numbers.....	369-370
Leafspot—	
Septoria of tomatoes, control studies.....	157
tobacco, control.....	156
Leather studies, Chemistry Bureau.....	215-216
Lectures, Roads Bureau work, addresses, and papers.....	383
Legal work, Department, 1918.....	393-424
Legislation—	
recent, for improvement of agricultural conditions.....	42-43
<i>See also</i> Laws.	
Legumes, acreage increase.....	362
Librarian, report, 1918.....	319-334
Libraries, Bureau and Division, activities and changes, etc.....	327-328, 329
Library—	
Crop Estimates Bureau, work of year.....	313
personnel, 1918, and changes.....	326-327
receipts and expenditures, 1918.....	333
reference and loan divisions, work, 1918.....	319-321
statistics, circulation, number of books, loans, etc.....	321, 322, 323, 328, 329-334
Weather Bureau, work, 1918.....	67
Lice—	
cattle, control.....	123
hog, control.....	123-124
Liming, soils, studies and publication relating to.....	230
Linters, cotton, handling and marketing, investigations.....	468
Live stock—	
conditions, monthly estimates.....	314
dealers' regulations.....	452-453, 487
demonstration work on reclamation projects.....	149-150
grazing, National Forests, numbers, permits, and management.....	166, 183-187
increase, results of extension work.....	354, 362
inspection, antemortem and post-mortem, condemnation, etc.....	98-100
interstate commerce, sanitary work.....	111-112
management on farms, investigations.....	494
market news service.....	21-22, 475-476
marketing, investigations.....	465-466
number, increase since 1914.....	6, 8
poisoning, causes, investigations.....	116, 117-148
production in cane-sugar and cotton districts.....	131-133
protection, value of weather warnings.....	60, 69
transportation and quarantine laws, violations.....	112
values with crops, 1914, 1917, 1918.....	8
Loans, seed grain, to farmers, conditions, number, and amount.....	32-35
Louisiana—	
drainage work and districts.....	389
Iberia Experiment Farm, work and demonstrations.....	131-133
Louse, body, investigations and control.....	243-244
Lung troubles, children and animals, caused by worms, note.....	125
Machinery, farm, use and care of, studies.....	495
Maine, sardine industry, conditions.....	209
Mallein, use in testing horses for glanders, number of doses, etc.....	76, 113, 122
Mammals—	
importations, 1918.....	271-272
reservations, work, 1918.....	267-269
Manganese, presence in insect powder, studies.....	427
Mange, hog, investigation and control.....	123
Manila maguey, growing and cleaning for use as fiber.....	161
Manure, borax-treated, fertilizing value.....	218

	Page.
Market News Service—	
enlargement and work of 1918.....	20-23, 53
reports.....	473-482
Market surveys, methods and costs, work of Markets Bureau.....	456-457
Marketing—	
cooperative organizations, investigations.....	456
direct, by parcel post and express, investigations.....	459-460
farm products, and distribution, investigations.....	456-468
foreign, investigations.....	462-463
Markets—	
inspection work.....	158
Bureau—	
cooperation with States in marketing work.....	473
investigations and demonstrations, work, 1918.....	452-473
legal questions, assistance of Solicitor.....	394, 419-421
publications, 1918.....	487-489
report of Chief, 1918.....	451-489
business practice and accounting systems.....	461-462
cotton, future and spot, investigations.....	483
grades and standards, investigations.....	457-458
live stock, supervision and publicity.....	51-52
local reporting service experiments.....	23
MARLATT, C. L., report as Chairman of the Federal Horticultural Board.....	431-449
MARVIN, C. F., report as Chief of Weather Bureau, 1918.....	57-70
Mealybug, citrus, control work.....	245-246
Meat—	
inspection—	
exemption, shipments under.....	101-102
law, violations, fines, etc.....	415-416
work, 1918.....	98-106
work of Animal Industry Bureau for Army and Navy.....	20
preservation by drying.....	122
production, increase since 1914.....	6, 8
products—	
inspection.....	101
substitutes for industrial purposes.....	122
supply, increase, work of Department, 1918.....	15
Meats—	
imported, inspection.....	102-103
market news service.....	21-22, 475-476
marketing, investigations.....	465-466
Medicines—	
analysis methods, studies.....	223
fraud, marketing by mail, work against.....	223
Mesquite wood, protection from insect destruction.....	245
Meteorology, agricultural, work of Weather Bureau, 1918.....	68-70
Mexico, pink bollworm situation.....	28-29, 437
Mildew, powdery, of apple, control.....	154
Mildew-proofing, studies, Chemistry Bureau.....	213-216
Milk—	
adulteration, discussion, important.....	203
condensed, laboratory work.....	96
market, investigations, 1918.....	83-84
production—	
cost.....	94
increase since 1914.....	6, 8
sanitary methods, and requirements.....	93-94
secretion, laboratory studies.....	95
Milking machines, studies.....	495
Milkweed, whorled, poisonous to live stock.....	118
Mills, dust explosions and fires, control work.....	211, 214
MOHLER, JOHN R., report as Chief, Animal Industry Bureau, 1918.....	71-133
Moles, trapping and use of skins.....	262
Moneys, public, various sources.....	278
Montana—	
ground squirrels eradication work.....	261
National Bison Range, conditions, 1918.....	268
rodent-extermination work, 1918.....	18

	Page.
Moth, peach, oriental, injury to various fruits, investigations.....	236, 249
Motion pictures—	
activities of Illustrations Section.....	299-301
use by Department for dissemination of information.....	38
Motor—	
transportation of farm products, investigations.....	460-461
truck service, work of Markets Bureau.....	481
vehicles, number, and fees collected and used on roads.....	382
Muck soils, subsidence, studies.....	390
Mules, number, increase since 1914.....	6, 8
Mustards, studies.....	217
Mutton, production, increase since 1914.....	6, 8
Napier, grass for forage.....	162-163
Naval stores, investigations.....	215
Nebraska, Niobrara Reservation, conditions, 1918.....	269
Negroes, cooperative work of county agents in South.....	358
NELSON, E. W., report as Chief, Biological Survey Bureau.....	257-275
Nematode, sugar beet, studies.....	156
Nevada, grazing lands, problems, discussion.....	173-174
News Letter, Weekly, circulation and scope.....	36-37
Nicotine, use against codling moth.....	235
Nitrates, effect on wheat, studies.....	218
North Dakota—	
ground squirrels, eradication work.....	261
rodent extermination, work, 1918.....	18
Sully's Hill Game Preserve, conditions, 1918.....	269
Nosema, disease of adult bees, investigations.....	253
Nursery stock, importations—	
by States, and by countries of origin.....	440-444
restrictions.....	29
Oak leaves, poisonous properties, studies.....	117
Oats—	
early, for corn belt, demonstration.....	163
grades, work of Markets Bureau.....	471
seed, treatment for smut control.....	361
Object-lesson roads. <i>See</i> Roads.	
Ocean meteorology, work of Weather Bureau, 1918.....	64
Ohio River flood, 1918, losses.....	65
Oidiomycosis, cattle, investigations.....	114-115
Oils, seed, investigations.....	221
Ornithology, economic, work of Biological Survey.....	263
Ostriches, investigations, 1918.....	85
Ozark region, farm-management problems, investigations.....	498
Pacific States, farm-management problems, investigations.....	499
Packing houses, supervision and regulation.....	51
PAGE, L. W., report as Director, Bureau of Public Roads, 1918.....	373-392
Paper making—	
use of flax straw, experiments.....	151
work of Chemistry Bureau.....	216
Parasites, animal, investigations.....	123-126
Parcel post, marketing, investigations.....	9-10
Parks, National, establishment in National Forests.....	170, 171
Pastures—	
management on reclamation projects.....	148
permanent, cooperative investigations.....	162
Patent, drying leaf tobacco, to control black rot.....	156
Patents, application by members of Department, status.....	421-424
Peach, insects injurious, investigations.....	236, 249
Pecans, growing and testing, work, 1918.....	152
Pectin, use in jelly making, studies.....	219
<i>Peranabrus scabricollis</i> , control.....	239, 248
Periodicals, work of Library, and statistics.....	324-325, 327, 331-332
Perishables—	
shipments, loading methods, improvement.....	464
transportation, value of weather forecasts.....	59

	Page.
Permits, grazing, National Forests, 1918, and management of live stock.....	183-187
Pharmacists, carelessness in dispensing drugs, control.....	207
Philippines, fiber growing for binder twine.....	161
Phosphoric acid, production, improved process.....	231
Photographic work, Roads Bureau, 1918.....	383
Pig clubs, enrollment and work, 1918.....	78
Pine—	
lumber, losses from beetle injury, investigations.....	244
white, blister rust, situation in various States.....	154-155
Plains States, farm management problems, investigations.....	499
Plant—	
chemistry studies.....	217-218
Industry Bureau—	
organization, work, and changes, 1918.....	135-136
report of Chief, 1918.....	135-164
Quarantine Act—	
administration, work of Solicitor.....	404, 405
violations, 1918.....	445
quarantine, cooperative work.....	444-445
quarantines, foreign and domestic, lists.....	447-449
Planting, program for 1919.....	9-10
Plants—	
breeding experiments, 1918.....	136-141
diseases, investigations.....	153-158
interstate shipments, terminal inspection.....	445
poisonous to live stock.....	117-118
quarantine—	
scope, administration, and personnel of Board.....	431
service, Texas, border regulations.....	436-437
requirements in soil.....	158-159
Plywood, construction and use in airplanes.....	196
<i>Popillia japonica</i> , introduction habits, and control.....	237
Pork, production—	
increase since 1914.....	6, 8
work of Animal Husbandry Division, 1918.....	72, 72-78, 82, 132
Porto Rico—	
Experiment Station, work, 1918.....	348-349
sisal and henequen growing, increase.....	161
Potash, recovery from blast furnaces, research work.....	231
Potato—	
aphis, control by nicotine sulphate.....	241, 249
wart, introduction into United States.....	445-446
Potatoes—	
acreage and production, 1914-1918.....	7
seed improvement, work.....	142
seed treatment for scab control.....	361
Poultry—	
breeding—	
and feeding, investigations, 1918, parasites, etc.....	78-80, 84-86, 116, 125
community work.....	85-86
clubs, enrollment and work of year.....	80, 85
handling, work of Chemistry Bureau.....	210
production, increase since 1914.....	6, 8
products—	
market news service.....	477
market news service, work, 1918.....	22
Prairie dogs—	
control work, 1918.....	18
eradication work, 1918.....	260
Printing—	
expenditures, 1918, and binding.....	282-286
Weather Bureau, work of 1918.....	66-67
Proteins, chemistry and nutritive value.....	218
Publications—	
Crop Estimates Bureau, 1918.....	314

Publications—Continued.

Department—	Page.
number and scope, 1918.....	35-36
sales by Superintendent of Documents.....	294-295
distribution, work of Document Section.....	301-304
Division—	
expenditures and work, 1918.....	282-304
report of Chief, 1918.....	281-304
food production and conservation, 1918.....	281-283
Library, 1918.....	326
Markets Bureau.....	487-489
1918, numbers and classes, and divisions issuing.....	281, 287-294
Weather Bureau, 1918.....	66-67
Purchasing, cooperative organizations, investigations.....	456
<i>Pyrausta nubilalis</i> , introduction, habits and control.....	237-238, 248
Quail, importation from Mexico.....	273
Quarantine—	
Division, work, 1918.....	104-106
live stock, law violations.....	112
plant. <i>See</i> Plant, quarantine.	
Quarantines, plant, foreign and domestic, lists.....	447-449
Quarry conditions, survey in relation to road materials.....	385-386
Quartermaster Department, stored goods, inspection by entomologists.....	240-248
Rabbits—	
domestic, raising for meat and fur.....	262-263
jack, control and utilization for food.....	261
Rabies—	
investigation.....	116
predatory animals, investigations.....	258-259
Range management, National Forests, grazing permits, and game... 183-187, 188-189	
Ranges, forest, grazing use for increase in meat production.....	19
Rats, control work.....	261-262
Reclamation, projects, demonstration agricultural industries.....	148-150
Records—	
crop, work of Crop Estimate Bureau.....	312-313
farm, bookkeeping and accounting problems.....	496
Reforestation, National Forests, work of 1918, acreage replanted.....	183
Refrigerator cars, investigations and improvement by Markets Bureau.....	463
Reporters, crop, voluntary, number and work, 1917, 1918.....	31, 309
Reservations, mammal and bird, location and work, 1918.....	266-271
Rhodes grass, adaptability to salty soils.....	162
Rice, damage by wild ducks and blackbirds.....	264
River service, Weather Bureau, work, 1918.....	65-66
Road materials—	
control by United States Highways Council.....	41
tests and research.....	383-387
Road projects, Federal-aid, assent of States, and action during.....	375-379
Roads—	
bituminous and nonbituminous, investigations.....	385-386
Bureau, report of Director, 1918.....	373-392
construction and maintenance, experimental work, 1918.....	381
Federal-aid—	
projects in National Forests.....	191-192
projects, statements and work.....	49-50
law, Federal-aid, administration, projects, miles, etc.....	375-379, 404-406
management and economics, surveys, models, and exhibits.....	381-383
National Forests, construction and funds available.....	189-192
Bureau, change of title from Roads Office.....	373
object-lesson, construction, and experimental work for States.....	381
Office, change of title to Bureau of Roads, note.....	373
Rock, road-building examination and testing.....	384
Rodents, control—	
relation to forage and crop production.....	266
work in Western States, 1918.....	18
work of Biological Survey, 1918.....	259-262
Root borer, banana, quarantine.....	444
Root-rot, <i>Thielavia</i> , of tobacco, control studies.....	156

	Page.
Rosin, studies, Chemistry Bureau.....	215
Rot, black, leaf tobacco, control.....	156
Rotations, various crops, farm practice studies.....	493
Rots, small fruits, prevention.....	153-154
Roundworms—	
hog, investigations and control.....	125
sheep, control.....	123
Rural, Engineering Office. <i>See</i> Roads Bureau.	
Rural organizations, investigations.....	456, 472
Rust—	
black stem, wheat, relation to barberry plants.....	153
blister, white pine, situation in various States.....	154-155
Saltbushes, composition, studies.....	218
Samples, food and drug, work of field stations, report, 1918.....	203-204
Sanitation, rural, importance and needs.....	53-54
Sardines, preservation, studies by Chemistry Bureau.....	209
Sawfly, injury to wheat, investigations.....	239-240
Scabies, sheep and cattle, eradication.....	107
Scald, apple, control.....	154
Scale, fluted, control work.....	246-247
Scarabee, sweet potato, cause of quarantine.....	444
Sea foods, conservation, work of Chemistry Bureau.....	208-209
Secretary, Agriculture, report, 1918.....	3-54
Seed—	
corn, selection and testing.....	361
grain, loans to farmers, conditions, number, and amount.....	32-35
market news service.....	478
marketing, investigations.....	466
oils, investigations.....	221
stocks, committee, emergency work, 1918.....	142-143
Seedlings, cotton, tomosis, cause.....	159-160
Seeds—	
distribution, 1918.....	164
market news service, work, 1918.....	23
purchase and sale to farmers, emergency work.....	142-143
quality, investigations.....	141-142
Seismological investigations, instrumental reports and others.....	67-68
Septoria, leaf-spot, tomato, control studies.....	157
Serum—	
antianthrax, preparation and use.....	116
antihog cholera—	
preparation methods, investigations.....	118-119
use at public stockyards.....	17, 74
Sewellel—	
injuries to crops, investigations.....	262
<i>See also</i> Beaver, mountain.	
Sheep—	
breeding and handling, parasites, etc.....	82, 123
fattening on farms, investigations.....	494
grazing in National Forests, numbers, conditions, etc.....	184, 185, 186, 187
numbers, increase since 1914.....	6, 8
production on reclamation projects.....	150
scabies, eradication.....	107
spewing sickness, cause.....	118
Shipments—	
meat, under exemption.....	101-102
perishables, loading methods, improvement.....	464
Silage investigations, fermentation, ripeness of crops, etc.....	95
Sirups, research work by Chemistry Bureau.....	219
Sisal, growing and cleaning for use as fiber.....	161
Sneezeweed, western, cause of spewing sickness of sheep.....	118
Snow measurements, work of Weather Bureau, 1918.....	65
Soda nitrate—	
purchase and distribution.....	452, 482
purchase and distribution by Department.....	38-39
purchase by Government, assistance of Solicitor.....	420

	Page.
Soil—	
indicators, value of natural vegetation.....	159
survey, work, 1918, review.....	225-228
surveys, cooperation with States.....	225
Soils Bureau, report of Chief, 1918.....	225-232
Solar radiation, investigations.....	68
Solicitor, report, 1918.....	393-424
Sorghums, grain, area and production, increase, 1918.....	147
South Dakota, Wind Cave National Game Preserve, conditions, 1918.....	268-269
Southern States—	
farm management demonstrations.....	499
live-stock extension work.....	80-82
Soy beans—	
composition, studies.....	217
improved varieties.....	140-141
Specialists, extension work in agriculture and home economics.....	357, 367-369
Spewing sickness, sheep, cause.....	118
Spruce, use in aircraft.....	180, 194-195
Squirrels, ground—	
control work, 1918.....	18
eradication work, 1918.....	260-261
Sugar, beet, industry, conditions, 1918.....	147-148
Sugars, study, Chemistry Division.....	219
Supplies, Army, examination, work of Chemistry Bureau.....	212
Surveys—	
drainage of farm lands, 1918.....	389
fertilizer, work of Markets Bureau.....	455-456
food, work of Markets Bureau.....	455
soil, cooperation with States, and work, 1918.....	225-232
Standards—	
cotton—	
investigations and demonstrations.....	469-470
preparation and distribution.....	483-484
grain, law enforcement, 1918.....	24-25
Starch, recovery from injured potatoes.....	152
Starling, food habits, study.....	264
States Relations Service, report of Director, 1918.....	335-371
Statistics—	
crops and live stock, 1914-1918.....	7-8
library, circulation, numbers of books, finances, etc.....	3, 10-16
publication work, 1918.....	287-288
Sterilizers, steam, for dairy use, demonstration work.....	93-94
Stocks, fruit-tree, investigations.....	152
Stockyards—	
regulation, work of Markets Bureau.....	452-453, 487
supervision and regulation.....	50
Storage—	
emergency, work of Markets Bureau.....	480
foodstuffs, investigations.....	469
fruit, investigations.....	151-152
grain, investigations.....	471
houses, construction improvement.....	464
sweet-potato, experiments.....	150-151
Storm, tropical, September, 1917, and weather warnings.....	60
Storms, warnings, work of Weather Bureau, 1918.....	60
Straw, flax, utilization for paper making.....	151
Swans, damage to duck-feeding grounds.....	264
Sweet potato—	
quarantine, revision.....	444
scarabee, cause of quarantine.....	444
weevil, eradication and control.....	241
Sweet potatoes—	
acreage and production, 1914-1918.....	7
storage experiments.....	150-151
Tanning—	
materials, forest supply, investigations and work.....	198
studies, Chemistry Bureau.....	215-216

	Page.
Telegraph service, Weather Bureau work, 1918.....	64-65
Tenancy, comparison with ownership, discussion.....	47-48
Testing cotton fiber.....	470
Texas—	
border quarantine service, disinfection of cars, etc.....	27-28
Denison, dairy demonstration work.....	89
pink bollworm—	
outbreaks, survey and quarantine work.....	432-437
quarantine work, 1918.....	26-27
THOMSON, E. H., report as acting Chief, Office of Farm Management.....	491-499
Thrashing machines, explosions and fires, control devices.....	211
Tick, cattle—	
eradication progress, 1918.....	16
eradication work, 1918.....	73, 108-110
Tile, clay, with wire and concrete, tests.....	390
Timber, sales, National Forests, amount and value.....	166, 179-182
Timothy, new strains, production.....	140
Tobacco—	
acreage and production, 1914-1918.....	7
diseases, control studies.....	156
Tomato, diseases, control work.....	156-157
Tomosis, cotton seedlings, cause.....	159-160
Tractors, use on farms, studies.....	495
Traffic, emergency, work of Markets Bureau.....	480
Tragacanth, substitute, study.....	221
Trails, National Forests, construction, and funds available.....	189-192
Transportation—	
foodstuffs, investigations.....	459, 460
live stock, law, violations.....	112
Trespass, National Forests, cases, damages and fines.....	400
Trichinae in pork, control methods.....	124
<i>Triodontophorus tenuicollis</i> , cause of colon ulcers in horse.....	125
Troops, forestry, organization, and work in Corps of Engineers.....	168
Truck crops—	
diseases, control studies.....	157
insects injurious, investigations.....	240-242, 248
reports of Crop Estimates Bureau, 1918.....	310-312
TRUE, A. C., report as Director, States Relations Service.....	335-371
Tubercle bacilli in market cheese, prevention.....	130-131
Tuberculin—	
laboratory studies.....	122
test, imported cattle, results.....	105-106
testing of cattle, cooperative work in States, results.....	110
Tuberculosis—	
animal, control work, 1918.....	17-18
eradication work, 1918, and investigations.....	74, 110-111, 114, 130
Turpentine, studies, Chemistry Bureau.....	215
Twenty-eight hour law, administration, fines, etc.....	416
Vaccine, blackleg, distribution.....	116
Vegetables—	
drying, work of Chemistry Bureau.....	209, 213
handling in transit and storage, for prevention of decay.....	463-464
insects injurious, investigations.....	240-242, 248
market news service.....	473-475
production, 1914-1918.....	7
Vegetation, natural, value as crop indicator.....	159
Veterinary education, progress.....	126-127
Vinegar—	
distilled, use as substitute for acetic acid in Paris green.....	212, 429
substitution for acetic acid in making Paris green.....	212, 429
Virgin Island Experiment Station, establishment and history.....	350-351
Virus Act, administration by Department.....	417-418
Virus-serum Control Office, work, 1918.....	128-129

	Page.
Walnut, black, production and demand, war emergency.....	198
War—	
activities—	
cooperation of Animal Industry Bureau.....	71-77, 125
Forest Service, 1918.....	165-166, 193-200
conditions and activities in Weather Bureau.....	57, 58-59, 63
emergency—	
entomological intelligence service.....	249-250
food use, instruction courses.....	371
research work, Forest Service.....	193-200
service, work of Library, 1918.....	327
work—	
cooperation, Chemistry Bureau, 1918.....	202, 211-214
Roads Bureau cooperation, 1918.....	373-375, 392
Warehouse Act, administration, Markets Bureau.....	486
Warehousing, cotton, investigations.....	469
Warnings, Weather Bureau, storms and cold waves, 1918.....	59-61
Wart, potato, introduction into United States.....	445-446
Water power—	
development, use, and permits in National Forests.....	187-188
protection, need of legislation.....	42
Water supplies from underground sources, studies.....	388
Waterproofing, various materials, studies, Chemistry Bureau.....	213, 215-216
Watersheds, forested, protection, cooperative work.....	193
Weather Bureau—	
Chief, report, 1918.....	57-70
printing and publications, 1918.....	66-67
publications, 1918.....	293-294
stations and observations, number and work, 1918.....	61-62
Weeks—	
forestry-law operations, work of Solicitor's Office.....	395, 406
law, land purchases.....	172
Weevil—	
alfalfa, progress and control.....	238
corn, black, destruction of stored corn.....	248
sweet potato, eradication and control.....	241
West Indies, weather stations, location.....	61
Wheat—	
acreage and production, 1918, comparison with previous years.....	5, 7
insects injurious, control work.....	239-240, 248
rust, black stem, relation to barberry plants.....	153
storage investigations.....	471
varieties, seed improvement.....	141-142
WHITNEY, MILTON, report as Chief, Bureau of Soils.....	225-232
Wilt—	
cotton, control by use of wilt resistant varieties.....	157
tomato, control by resistant varieties.....	156-157
WILLIAMS, WILLIAM M., report as Solicitor.....	393-424
Wines, composition, study.....	219
Wintering bees, investigations.....	252-253
Wisconsin, hemp growing, increased acreage and production.....	162
Wood, fuel use, increase.....	199
Wool—	
production, increase since 1914.....	6, 8
reports, market news service.....	476
Women, farm, demonstration and extension work.....	355, 366-367
Wyoming, elk refuge, conditions, 1918.....	267-268
Yellows, alfalfa, studies.....	155
ZAPPONE, A., report as Chief of Accounts and Disbursements Division, 1918.....	277-279

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